

The Milbank Memorial Fund
QUARTERLY

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Vol. XXVI

JANUARY 1948

No. 1

Edited by the Technical Staff

Published quarterly by the MILBANK MEMORIAL FUND, 40 Wall Street,
New York 5, New York. Printed in the U. S. A. Subscription: \$1.00 a year.

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IN THIS ISSUE

THE Annual Conference of the Milbank Memorial Fund, held at the New York Academy of Medicine, November 19-20, 1947, included a round-table discussion on "Backgrounds of Social Medicine." The term social medicine, which is now heard so frequently, expresses a broad concept of the inter-relationship of health and disease and man's total environment, *e.g.*, the conditions and situations under which he lives, works, recreates, and finds self-expression. Policy and practice in social medicine are the application of procedures and techniques for adjusting man to environment or of controlling and modifying environment to protect and serve the health needs of man. Basic to the development of methods is knowledge of the effects, good and bad, of various aspects of environment on health. At the Round Table on "Backgrounds of Social Medicine," the present status of evidence on the association of various factors in environment with major causes of ill health was reviewed and considered with special reference to types of investigations needed to improve our knowledge of such associations.

Reports read at the round table are being published in this and later issues of the *Quarterly*. In the current issue, the historical aspects of the study of disease in relation to environment and of the development of the concept of social medicine are reviewed by Dr. George Rosen in the article entitled "Approaches to a Concept of Social Medicine." Ideas of medicine as a social science began to take form about a century ago, and the lines of development in Germany, England, and the United States are traced by Dr. Rosen.

Conditions associated with occupation make up a significant part of the physical environment of the employed

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members of the population. Data relating to health of various occupation groups is presented by Dr. Ruth R. Puffer in a paper on "Industrial and Occupational Environment and Health." Problems of specific occupational diseases have been studied intensively in the United States and have received much attention. This report is concerned with the general health problems of industrial workers and with the need to improve our data on morbidity and mortality statistics for various occupational groups for the purpose of developing broader and better health programs in industry.

In the article "The Place of Nutrition in the Relationship Between Environment and Health," Dr. H. D. Kruse points out that nutrition as a bodily process occupies a key position in the association. He brings forth existing evidence from human studies of the effect of environmental conditions on nutrition and its influence in turn on them or on man's reaction to them. In order to visualize these relationships it is necessary to recognize the nature of nutritional abnormalities and their etiology. Besides reiterating his previously enunciated view on the nature of deficiency states, Dr. Kruse presents a new concept of their etiology which includes and integrates all environmental conditions in their effect on nutrition. From these relationships emerges a reciprocity of Nature as exemplified by the effect of physical growth, pregnancy, and disease on nutrition and vice versa.

Intimations that nutrition makes its imprint upon other facets of life and well-being, for example, congenital deformities, physical performance, aging, and longevity, provide promising subjects for test on man in the future. In these studies the new concepts of the nature of malnutrition and its causal complex may be useful guides. Furthermore, they offer a fresh approach in the exploration of chronic disease. Withal, nutrition is seen to be a tangible, material, and crucial medium between environment and health.

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In recent years, the leaders in public health and medicine have become concerned over the wide disparity between the medical and health services and facilities available to urban

populations and to village and farm populations in the United States. To a considerable degree, this situation has existed for a long time, if not always, but it is made more acute as the practice of modern medicine and of modern public health requires a variety of trained specialists, hospitals, and much expensive equipment. Other countries, too, have recognized and are trying to solve the special problems involved in bringing adequate health services to rural groups. In the article "Rural Health Programs in Different Nations," published in the following pages, Dr. Milton I. Roemer, of the United States Public Health Service, discusses various aspects of the rural health problem and describes the methods used by many different countries to make personnel and facilities available and to provide the funds needed to pay for them.

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The association of certain chronic diseases in the same person has in the past been studied in various ways. In the paper "A Statistical Study of Cancer Among Diabetics," Paul H. Jacobson appraises the results of studies of the association of these diseases in populations composed of dead persons and presents an analysis of their association among the living. Data for adult white persons from a recent morbidity survey indicated that cancer was more prevalent than expected among diabetics, and apparently the incidence of cancer was higher among diabetics than among non-diabetics. The findings from studies such as this are of more than academic interest. They indicate the need for further study of the association of chronic conditions.



APPROACHES TO A CONCEPT OF SOCIAL MEDICINE. A HISTORICAL SURVEY

GEORGE ROSEN, M.D., PH.D.¹

THE practice of medicine has always been linked with the social and economic conditions of particular groups of people, but in earlier periods these relations were only rarely made the subject of theoretical discussion. Not until modern times does there appear a clear awareness that intimate bonds link social conditions and medical problems. During the eighteenth century, the need for consideration of social viewpoints in dealing with problems of medicine and hygiene was recognized by a number of medical men, of whom Johann Peter Frank is probably best known in this connection. It was left for the nineteenth century, however, to develop the idea of medicine as a social science, and eventually to formulate with greater precision and clarity a concept of social medicine.

The idea of medicine as a social science was first clearly presented in connection with the medical reform movement that developed in Germany during the revolution of 1848. Led, among others, by Rudolf Virchow and Salomon Neumann, German physicians joined forces to secure long overdue medical reforms. Basic to their thinking is the view vigorously asserted by Neumann in 1847, that "medical science is intrinsically and essentially a *social science*, and as long as this is not recognized in practice we shall not be able to enjoy its benefits and shall have to be satisfied with an empty shell and a sham."²

It is clear from contemporary discussions that the proponents of this idea were not dreaming of some medical Cloudcuckoo-land, but employed it rather as a convenient formulation under which to sum up definite principles. The *first* of these is that

¹ District Health Officer, Fort Greene Health Center, Brooklyn.

² Neumann, Salomon: *DIE ÖFFENTLICHE GESUNDHEITSPFLEGE UND DAS EIGENTUM. KRITISCHES UND POSITIVES MIT BEZUG AUF DIE PREUSSISCHE MEDIZINALVERFASSUNG—FRAGE*, Berlin, Adolph Riess, 1847, pp. 64–65. For an excellent analysis of the German medical reform movement of 1848, consult the monograph of Ackerknecht, Erwin H.: *Beiträge zur Geschichte der Medizinalreform von 1848. Sudhoff's Archiv für Geschichte der Medizin*, 1932, 25; pp. 61–109, 112–183.

the health of the people is a matter of direct social concern. Society has an obligation to protect and ensure the health of its members. The *second* principle is that social and economic conditions have an important effect on health and disease, and that these relations must be subjected to scientific investigation. Furthermore, if society has an obligation to protect the health of its members, and it is recognized that social and economic conditions have an important effect on health and disease, then it follows logically that steps must be taken to promote health and to combat disease, and that the measures involved in such action must be social as well as medical. This is the *third* principle involved in the idea of medicine as a social science, and was recognized by Virchow, Neumann, and the other medical men who participated in the movement of 1848.

In consonance with these principles, voices were raised for governmental action, and many specific measures were proposed. Provision of medical care for the indigent was a problem of great urgency, and proposals were put forth by Virchow and others for public medical services for the poor, including free choice of physicians.³ It was realized, however, that provision of medical care was not enough, that it must go hand in hand with social prophylaxis. In consequence, we find Virchow proclaiming the right of the citizen to work as a fundamental principle to be included in the constitution of a democratic state.⁴

The problem of the industrial worker also demanded attention. As in England and France, industrialization in Germany was ushered in by a slaughter of the innocents. Those that survived the cradle were given over to the tender mercies of the factory and the mine. To deal with this problem, Leubuscher,

³ DIE MEDICINISCHE REFORM. EINE WOCHENSCHRIFT, ERSCHIENEN VOM 10. JULI, 1848 ZUM 29. JUNI, 1849, Berlin, Druck und Verlag von G. Reimer, pp. 127, 185, 189, 190.

⁴ *Ibid.*, p. 38. Here Virchow was influenced by the action of the French Provisional Government of 1848 in recognizing the right to work, the doctrine of the *Droit au travail* that Louis Blanc had been preaching since 1839. See Marriott, J. A. R. (Ed.): THE FRENCH REVOLUTION OF 1848 IN ITS ECONOMIC ASPECT. VOL. I. LOUIS BLANC'S ORGANISATION DU TRAVAIL. . . . Oxford, Clarendon Press, 1913, pp. XXXVI-LXIX.

an associate of Virchow, proposed a program of industrial hygiene, with emphasis on the legislative regulation of working conditions.⁵ Leubuscher advocated the prohibition of child labor before the age of fourteen, reduction of the working day in dangerous occupations, protection of pregnant women in industry, the establishment of standards for ventilation of work rooms, and the prevention of industrial poisoning through the use of non-toxic materials.

Very important was the recognition that for investigation of the causal relations between social conditions and medical problems it was necessary to have reliable statistics. Neumann was active in agitating for the collection of accurate statistical information on all elements of social life that in any way have a bearing on problems of health and disease.⁶

With the defeat of the revolution of 1848, the medical reform movement came to a quick end. The views of Virchow and his collaborators did not mature in their own day, but the seed had been sown.

While the German democrats proclaimed the preeminence of human rights and human dignity, and accepted the logical consequences of this position in relation to health and disease, liberal theory in England had emerged as a doctrine of economic *laissez faire*. This philosophy, with its acceptance of social atomism and the predetermined harmony of man and nature manifesting itself through inexorable economic laws, carried with it a stubborn insistence on the absolute necessity of submission to the supposed laws of society. Protests against the ill effects of economic liberalism on the lives of men did not substantially alter the doctrine. Discrepancy between social fact and social theory was not generally recognized as affecting the hard central core of economic liberalism, and it was not until the latter part of the nineteenth century that the gradual and

⁵ Leubuscher, R.: Zur Reform der Sanitätspolizei, *Medicinische Reform*, pp. 11-12, 47-49.

⁶ Neumann, *op.cit.*, p. 84; S. Neumann; Zur medizinischen Statistik des preussischen Staates nach den Acten des statistischen Bureau's für das Jahr 1846, *Archiv für pathologische Anatomie und Physiologie und für klinische Medicin*, 1851, 3; pp. 13-141 (see pp. 86-89).

peripheral erosion which had been carried on in practice began to receive conceptual recognition.

Such an intellectual environment was hardly conducive to theoretical analyses of the social aspects of health and disease, and no thoroughgoing formulations were developed. Yet certain incontrovertible facts insisted upon intruding themselves into public consciousness. Questions of ill-health, poor housing, dangerous and injurious occupations, excessive morbidity and mortality could not be overlooked, and investigations of these social problems were undertaken to find out how they had arisen.

Thus, in 1832, James Philips Kay published a study of *THE MORAL AND PHYSICAL CONDITION OF THE WORKING CLASSES EMPLOYED IN THE COTTON MANUFACTURE IN MANCHESTER*. It was the high incidence of communicable disease that led Kay to investigate the Manchester workers, and he found illness, poverty, vice and physical degradation all intimately interlocked.⁷ Nevertheless, this anatomy of social misery is so permeated by the bleak gospel of economic orthodoxy that Kay can see no necessary relation between the existing socio-economic organization and the various forms of social pathology that he found.

Some physicians did recognize, however, that social and economic institutions, especially industrialism, had significant and necessary connections with the health problems of the factory workers. Outstanding in this respect was C. Turner Thackrah, whose pioneer treatise on occupational medicine first appeared in 1831. This book became a bible among the factory reformers, and Thackrah actively supported the struggle to restrict child labor.⁸

⁷ Kay, J. P.: *THE MORAL AND PHYSICAL CONDITION OF THE WORKING CLASSES EMPLOYED IN THE COTTON MANUFACTURE IN MANCHESTER*. London, James Ridgway, 1832, pp. 40-42.

⁸ Thackrah, C. Turner: *THE EFFECTS OF ARTS TRADES AND PROFESSIONS, AND OF CIVIC STATES AND HABITS OF LIVING, ON HEALTH AND LONGEVITY*. Second Edition, Greatly Enlarged, London and Leeds, 1832, p. 80. The present writer has in his possession a copy of the second edition of Thackrah's book with a presentation inscription by the author to Michael Thomas Sadler, parliamentary spokesman of factory reform. See also Driver, Cecil: *TORY RADICAL. THE LIFE OF RICHARD OASTLER*. New York, Oxford University Press, 1946, pp. 73, 135-136.

As the decade of the 'thirties passed, however, and the 'forties came to occupy the scene, a gradual but definite shift in thought on the social aspects of health and disease became evident. The reports to the Poor Law Commission culminating in 1842 in Chadwick's classic *INQUIRY INTO THE SANITARY CONDITION OF THE LABOURING POPULATION OF GREAT BRITAIN*, and in 1844 in the report of the Health of Towns Commission provided a factual base for this ideological maneuver. Empirical recognition of the causal relations between social problems and medical conditions went hand in hand with programs for remedial action, but hardly any effort was made to develop a theoretical foundation for such programs.

On this account high praise is due Henry W. Rumsey, who, in 1856, in a volume entitled *ESSAYS ON STATE MEDICINE*, undertook to formulate a theory of public health and medical care within a framework of social organization and action, in short, a social policy for medicine. Rumsey emphasized that the promotion of health and the prevention of disease were matters of social concern and required governmental action.⁹ He pointed out that various forms of illness were caused by factors in the social environment, laid great stress on health education, and urged that "district medical officers" be appointed to execute the proposed policies.¹⁰

At the time when Rumsey expressed these views, the health officer was still a novelty, the first official of this character having been appointed in 1847 at Liverpool.¹¹ The appointment of health officers for various towns and districts, as well as increased interest in public health, in 1856 led the authorities of St. Thomas's Hospital to establish a course of lectures on public health, the first of its kind in England.¹² Edward Headlam

⁹ Rumsey, Henry W.: *ESSAYS ON STATE MEDICINE*. London, John Churchill, 1856, p. 248.

¹⁰ *Ibid.*, pp. 280-282.

¹¹ Simon, John: *ENGLISH SANITARY INSTITUTIONS*. London, John Murray, 1897, pp. 246-248.

¹² John Simon relates that the "arrangements at St. Thomas's Hospital were in adoption of proposals which I, as member of the School, had made there" (*ENGLISH SANITARY INSTITUTIONS*, p. 266, footnote).

Greenhow was appointed to this lectureship, and in preparation for his first course of lectures undertook to collect statistical information on the preventable causes of disease. At the request of John Simon, this study appeared in 1858 as a parliamentary report of the General Board of Health.¹³ Greenhow came to the conclusion that numerous environmental factors cause preventable disease, and that "some of these causes of preventable sickness and premature death arise necessarily from the circumstances of our social system. . . ." As an example, he discussed the relation of infant mortality to the employment of mothers in factories.¹⁴

During the period 1862-1865, John Simon as medical officer to the Privy Council undertook various medical studies on its behalf, concerning himself particularly with the investigation of "foodsupply, of house accommodation and the physical surroundings, and of industrial circumstances. . . ." The studies showed that these factors were causally related to the prevalence of ill-health among British workers.¹⁵

Clearly, by the decade of the 'sixties, considerable advance had been made in Britain toward a more socially oriented view of health and disease. Although this position was not as sharply defined as the German idea of medicine as a social science, various medical writers and administrators had recognized that social and economic conditions were intimately related to the greater or lesser prevalence of disease, and that these relations should be made the subject of exact scientific investigation, utilizing in considerable measure statistical materials and methods. Economic liberalism was still the dominant social philosophy, but in practice it was gradually being recognized as ulti-

¹³ General Board of Health: PAPERS RELATING TO THE SANITARY STATE OF THE PEOPLE OF ENGLAND: BEING THE RESULTS OF AN INQUIRY INTO THE DIFFERENT PROPORTIONS OF DEATH PRODUCED BY CERTAIN DISEASES IN DIFFERENT DISTRICTS IN ENGLAND; COMMUNICATED TO THE GENERAL BOARD OF HEALTH BY EDWARD HEADLAM GREENHOW, M.D. . . . WITH AN INTRODUCTORY REPORT BY THE MEDICAL OFFICER OF THE BOARD, ON THE PREVENTABILITY OF CERTAIN KINDS OF PREMATURE DEATH. LONDON, Eyre and Spottiswoode, 1858.

¹⁴ *Ibid.*, pp. 131-133.

¹⁵ Simon, John: PUBLIC HEALTH REPORTS (2 vols.). London, J. and A. Churchill, 1887, vol. II, pp. 97-98. Also ENGLISH SANITARY INSTITUTIONS, p. 293.

mately untenable for an industrial society. For example, the establishment of a system of free medical advice to all the wage-earners in England and Wales was seriously under consideration in 1870 by the Poor Law Board.¹⁶ It was in the decade of the 'eighties however, that the interplay of long-term trends and particular events came to focus in new formulations of social problems and values. Out of this rephrasing of social goals and ideologies there would in time develop a theory of social medicine.

But while British developments were still in the future, a well-developed system of social medicine had already been presented in 1865 by Meynne, a Belgian army doctor, in his *TOPOGRAPHIE MÉDICALE DE LA BELGIQUE*. Under the influence of the Industrial Revolution in England, and the urgent necessities of the Napoleonic Imperium, Belgium had early achieved a high degree of industrialization. Grave social problems followed in the wake of this development, not the least of which was wide prevalence of disease in the industrial population. Studies and inquiries into the social, economic, and medical status of the Belgian people during the thirty years preceding the publication of his book placed at Meynne's disposal a considerable mass of data, a circumstance reflected in the scope and comprehensive character of his work.

The *TOPOGRAPHIE MÉDICALE* is divided into four parts. The first deals with the geography, geology, and climatology of Belgium; the second with the morbidity and mortality of the Belgian population, including a discussion of the causes of the most prevalent or most serious diseases; the third with the relations of the diseases to soil, climate, poverty, nutrition, housing, and alcoholism; and finally, the fourth section is concerned with a discussion of various measures designed to alleviate or remove the conditions previously described. Meynne makes full use of statistical materials, for he recognized that statistics provided a formidable instrument for the study of the problems in which he

¹⁶ Webb, Sidney and Webb, Beatrice: *THE STATE AND THE DOCTOR*. London, Longmans, Green and Co., 1910, p. 7.

was interested. Special attention must be called to chapter VI of Meynne's treatise. Here he takes up the diseases of greatest importance, analyzes each in terms of its causation, and indicates the social factors involved. This section is unique, for not until Grotjahn's *SOZIALE PATHOLOGIE* do we again find this kind of analysis.¹⁷

During the latter half of the nineteenth century, the idea of a social medicine was kept alive in Germany by a few far-seeing and socially minded men. A number of medical men in varying degree recognized the importance of the influence of social conditions on health, and discussed this subject from varying points of view.

One of the most interesting of these, and yet one of the least known, is Eduard Reich (1836-1919), an eccentric and peripatetic medical scholar.¹⁸ In his *SYSTEM PER HYGIENE* which appeared in 1870-1871 in two volumes, Reich set up four branches of hygiene: moral, social, dietetic, and police hygiene. Within these categories, he undertook to explore human experience, both personal and social, as it bore on health. While Reich's categories are not entirely congruent with those in use at present, his social hygiene may be regarded as an early concept of social medicine and social work. Social hygiene, he asserted, studies phenomena of social life in order to maintain the well-being of the community.

The ideas of Eduard Reich remained almost unknown, but similar views were expressed by his better-known contemporary, Max von Pettenkofer, and reached a wide audience. It was Pettenkofer who made hygiene an experimental laboratory science,¹⁹ yet he was fully aware that man's health is influenced not only by his physical environment but also by the social

¹⁷ Meynne: *TOPOGRAPHIE MÉDICALE DE LA BELGIQUE*. Bruxelles, H. Manceaux, 1865, pp. 123-235.

¹⁸ Reich, Eduard: *SYSTEM DER HYGIENE* (2 vols. in one). Leipzig, Friedrich Fleischer Verlag, 1870-1871. See particularly in volume I, pp. XII, XVI, XXII, 267. For Reich consult Fischer, Alfons: *GESCHICHTE DES DEUTSCHEN GESUNDHEITSWESENS* Bd. II. Berlin, F.A. Herbig, 1933, pp. 362-365.

¹⁹ See von Pettenkofer, Max: *The Value of Health to a City, Two Lectures*, Delivered in 1873, Translated from the German, with an Introduction by Henry E. Sigerist, *Bull. History of Medicine*, 1941, 10, pp. 597; 602.

world in which he lives. In view of this standpoint, it is not at all surprising to find Pettenkofer, in 1882, employing the term social medicine for hygiene.²⁰

The significant influence that social institutions and conditions exert upon health was also pointed out in 1874 by Nikolaus Alois Geigel, professor of hygiene at Würzburg. He dealt with the effects of the rise of capitalism, the growth of an industrial proletariat, increasing urbanization and the unhygienic conditions under which workers were compelled to live, and the relations of these changing social and economic conditions to health and disease. Like many of his predecessors and contemporaries, Geigel insisted on the need for accurate statistics that would throw light on social phenomena.

Nevertheless, despite an awareness of the social relations of health and disease, the last three decades of the nineteenth century in Germany were characterized by a social and cultural environment which was unfavorable for the development of this awareness to a clear concept that would admit of practical medical application. To most Germans after 1871, the movement of 1848 was something from a distant past. The national aspect of the movement was still recognized, but the social ideals had been abandoned. At the same time bacteriology made its appearance with what seemed to be the answer to the problem of disease causation. Under these conditions, it was not difficult to overlook the patient and his environment, and to equate germs and disease in the relationship of cause and effect.

At the very time, however, when Emil Behring was proclaiming bacteriology as the ultimate medical truth and Koch as its prophet, a young German medical student in search of a subject for a doctoral dissertation conceived the idea of systematically investigating medical problems in the light of social science, so as "to arrive finally at a theory of social pathology and social hygiene, which with its own methods . . . would be used to investigate and to determine how life and health, particularly of

²⁰ Pelc, Hynek: *La médecine sociale et son développement en Tchécoslovaquie. Bruxelles médical*, April 26, 1936, No. 26.

the poorer classes, are dependent on social conditions and the environment."²¹ The student was Alfred Grotjahn, who in pursuit of this aim produced a concept of social hygiene (Grotjahn preferred the term social hygiene to social medicine), which initiated the theoretical development of social medicine during the first half of the twentieth century.

Grotjahn's theory received its fullest expression in the best known of his many publications, the classic *SOZIALE PATHOLOGIE*, which first appeared in 1911 and went through several editions. In it he advanced a number of principles that are fundamental for a systematic study of human disease from a social viewpoint.²²

1. The significance of a disease from a social point of view is determined in the first place by the *frequency* with which it occurs. Medical statistics are therefore the basis for any investigation of social pathology.

2. A disease becomes socially significant not only through the frequency of its occurrence. It is necessary also to know the *form* in which the particular disease occurs most frequently. As a rule, the characteristic textbook form is not the one in which the disease occurs most often, nor is it generally the form which is most affected by social conditions or in turn affects them. Consequently, it is necessary to determine the socio-pathological typical form.

3. The most important relations between diseases and social conditions are in the realm of causation. The etiology of disease is biological and social. The social basis of disease may be considered under the following heads: Social conditions (a) may create or favor a predisposition for a disease; (b) may themselves cause disease directly; (c) may transmit the causes of disease; and (d) may influence the course of a disease.

²¹ Behring, E.: *GESAMMELTE ABHANDLUNGEN ZUR ÄTIOLOGISCHEN THERAPIE VON ANSTECKENDEN KRANKHEITEN*. Leipzig, George Thieme, 1893, p. xix; Grotjahn, Alfred: *ERLEBTES UND ERSTREBTES. ERINNERUNGEN EINES SOCIALISTISCHEN ARZTES*. Berlin, F. A. Herbig, 1932, p. 72.

²² Grotjahn, Alfred: *SOZIALE PATHOLOGIE. VERSUCH EINER LEHRE VON DEN SOZIALEN BEZIEHUNGEN DER MENSCHLICHEN KRANKHEITEN ALS GRUNDLAGE DER SOZIALEN MEDIZIN UND DER SOZIALEN HYGIENE*. Zweite Neubearbeitete Auflage, Berlin, August Hirschwald Verlag, 1915, pp. 9-18.

4. Not only are the origin and course of diseases determined by social factors, but these diseases may in turn exert an influence on social conditions. This influence is exerted particularly through the outcome of the disease. It may manifest itself in death, recovery, chronic infirmity, predisposition for other illness, and finally, in degeneration.

5. In the case of a disease which is important from a social viewpoint, it must be established whether medical treatment can exert an appreciable influence on its prevalence, and whether, such therapeutic success as may be achieved is important from a social point of view.

6. How can we prevent diseases or influence their course by social measures? This requires attention to the social and economic environment of the patient.

Grotjahn realized that many diseases of social importance were chronic in character. Recognizing that a large number of these were preventable, he felt that health education could be an extremely important factor in this connection. He was also of the opinion that the physician should use his position to promote developments in social hygiene so that the benefits of medical knowledge could be applied to all the people. For the physician to understand these responsibilities, Grotjahn saw that the teaching of social hygiene would have to become a part of the medical curriculum. He himself taught at the University of Berlin, and academic instruction was also given at other German and Austrian medical schools. Finally, he emphasized that in its investigations social hygiene would make use of the methods of statistics, demography, anthropology, economics, sociology, as well as those of medicine itself.

Grotjahn was not an isolated phenomenon. He was only the outstanding figure of a group of men who during the first two decades of the twentieth century developed the theory of social medicine so that it could be used in medical practice and medical education. Prominent in this group were also Ludwig Teleky, Adolf Gottstein, and Alfons Fischer. Teleky added an important element for an understanding of the nature of social

medicine. By making use of the concept of social class, and calling attention to its prominent role in the study of health differentials, he introduced a significant methodological tool.²³ The advance in the theory and practice of social medicine in Germany up to the outbreak of the First World War is summed up in the statement made in 1913 by Adolf Gottstein: "Social etiology can now be regarded as accepted."²⁴

The concept of social medicine developed in Germany, in particular the ideas of Grotjahn, had a wide influence on the theoretical development of this field in other countries, notably, in Central and Eastern Europe. Social medicine has been developed in greater or lesser degree by the Scandinavian countries, the Soviet Union, Italy, France, Czechoslovakia, Switzerland, Holland, Belgium, and Yugoslavia.

In Great Britain, as in the United States, interest in the development of a concept of social medicine is a recent phenomenon. The social relations of health and disease had been recognized by physicians and laymen, but owing to a number of causes no concerted effort had been made to organize such knowledge on a coherent basis and thus make it available for practical application. In part this was due to the dominant role that laboratory sciences and techniques had come to play in medicine, in part to the concurrent rise and expansion of medical specialism, and in part to the limited view of public health that had been current in both countries. Furthermore, the bias created by these factors was reinforced by powerful social ideologies still rooted in the nineteenth century version of natural law.

During the past few decades, however, influences within medicine itself and in society as a whole have acted to overcome these factors. The development of such branches of medicine as endocrinology, nutrition and psychiatry tended to break down the compartmental thinking of the physician, and to

²³ Teleky, Ludwig: Die Aufgaben und Ziele der sozialen Medizin. *Wiener Klinische Wochenschrift*, 1909.

²⁴ Mosse, M. and Tugendreich, G. (Eds.): *KRANKHEIT UND SOZIALE LAGE*. München, J. F. Lehmanns Verlag, 1913, p. 722.

bring back into mental focus the sick person, the patient. Moreover, within society as a whole, the ideology of complacent individualism was wearing thin, and consciousness of social problems, including those involving health, became exceedingly acute.²⁵ The concept of the welfare state achieved articulate prominence during the threatening thirties, and culminated during the following decade in the famous Beveridge Report.

Symptomatic of these trends is the fact that by 1943 an Institute of Social Medicine was set up at Oxford, with John A. Ryle as Professor of Social Medicine. Some two years later, F. A. E. Crew was appointed to a chair of social medicine at Edinburgh. While these British developments are of great interest, and hold considerable promise for the future, the conceptual apparatus employed by Ryle and Crew in their theoretical expositions does not yet seem to be as well developed as that of the German writers mentioned above.²⁶

The roots of social medicine in the United States are to be found in organized social work which emerged out of organized charity during the nineties of the last century.²⁷ It was here that medicine and social science found a common ground for

²⁵ See, for instance, Ott, J. B.: *FOOD, HEALTH AND INCOME* (1936); M'Gonigle C. M. and Kirby, J.: *POVERTY AND PUBLIC HEALTH* (1936); Titmuss, R. M.: *POVERTY AND POPULATION* (1938). The subtitle of the last book—*A FACTUAL STUDY OF CONTEMPORARY SOCIAL WASTE*—with its reference to the wastage of human lives, characterizes the point of view of most of these writers. In this connection the work of the Peckham Health Centre is also significant. See Pearse, I. H. and Williamson, G. S.: *THE CASE FOR ACTION*. London, Faber and Faber, 1931; *BIOLOGISTS IN SEARCH OF MATERIAL. AN INTERIM REPORT ON THE WORK OF THE PIONEER HEALTH CENTRE PECKHAM*. London, Faber and Faber, 1938; and Pearse, I. H. and Crocker, Lucy H.: *THE PECKHAM EXPERIMENT. A STUDY IN THE LIVING STRUCTURE OF SOCIETY*. London, George Allen and Unwin, Ltd., 1943.

²⁶ For a more extended critique see Rosen, George: *What is Social Medicine? A Genetic Analysis of the Concept*. *Bulletin of the History of Medicine*, 1947, 21. (In press).

²⁷ Devine, Edward T.: *WHEN SOCIAL WORK WAS YOUNG*. New York, Macmillan Company, 1939; Hamilton, Alice: *EXPLORING THE DANGEROUS TRADES*. Boston, Little, Brown and Company, 1943, pp. 53-117.

Contributions to specific social aspects of health or to medical problems having social implications are to be found scattered throughout the American medical and public health literature. One need only consult, for example, the early volumes of the reports of the American Public Health Association, or to recall the names of Daniel Drake, John H. Griscom, Stephen Smith, Lemuel Shattuck, John Shaw Billings, William H. Welch, Hermann M. Biggs, Joseph Goldberger, Louis I. Dublin, and Alice Hamilton to ascertain this fact. Nevertheless, it is true that these data have never been brought together as a basis for a theory of social medicine.

action—in the prevention of tuberculosis, decent working conditions in factories, better housing, and the like. Out of this background Francis Lee Dunham in 1925 tried to develop a concept of social medicine. Basic to the origin of this concept, according to Dunham, was the need in welfare work “for a field of preventive medicine to which social science, psychology, psychiatry, and various other departments shall contribute but upon no one of which shall the entire burden of responsibility fall. Such a field functions more naturally as an attitude, a point of view, rather than as a specific department. It may be called *Social Medicine* and its technic AN APPROACH TO THE FIELD OF SOCIAL MEDICINE.”²⁸ In defining the scope and function of social medicine, Dunham put the emphasis on social and personal adjustment. Social medicine, he said, helps to harmonize human behavior, and to organize conduct. The eugenic approach to social problems is clearly evident in Dunham’s thinking and the shadow of William Graham Sumner still falls on this pioneer American attempt to formulate a concept of social medicine.

This venture remained stillborn. It may well be that the almost exclusive concentration on the economic aspects of medical care, which began with the work of the Committee on the Costs of Medical Care militated against the development of a theory of social medicine. One might expect that the advent of the depression would have turned the minds of some in this direction. Nevertheless, with one outstanding exception, this was not the case. The exception was Edgar Sydenstricker, who, in 1933, brought out his study on HEALTH AND ENVIRONMENT. In this monograph, he carried out a masterly analysis of the idea of environment into its component aspects, and then showed the relation of each of these to health problems. Sydenstricker thus laid the basis for a theory of social medicine, but unfortunately he never went on to develop such a theory.

The need for a conceptual formulation, for a theory of social

²⁸ Dunham, Francis Lee: AN APPROACH TO SOCIAL MEDICINE. Baltimore, Williams and Wilkins Company, 1925, p. 30.

medicine is widely recognized in the United States at present. At the same time, it is evident that American thought on social medicine is still in a fluid condition. Much of the thinking is too vague and fuzzy to be of practical value.

Historically, the appearance of a concept of social medicine occurred in response to problems of disease created by industrialism. To a very considerable extent the history of social medicine is also a history of social policy. Based on the twin pillars of medicine and social science, the concept of social medicine could become more precise only with the advance of knowledge and thought in these two fields. Fundamental to a concept of social medicine is its concern with what is true of the health of man by virtue of the fact that he leads a group life. Its scope may therefore be delimited in terms of three significant aspects: (1) health in relation to the community, (2) health as a social value, and (3) health and social policy.

In conclusion, if Goethe was right when he said, *Die Geschichte der Wissenschaft ist die Wissenschaft selbst*, then the historical survey of the concept of social medicine that I have attempted can contribute to a better understanding of the complex problems of this field by providing a point of departure for further exploration.

INDUSTRIAL AND OCCUPATIONAL ENVIRONMENT AND HEALTH

RUTH R. PUFFER, DR.P.H.¹

IN 1940, the labor force of the United States included fifty-three million persons, or 40 per cent of the population. This large group of workers is a major group to consider in improving the health status of our population and in providing services for the maintenance of good health. Perhaps the most logical approach in the problem of social medicine is to work with this group, to study the problems of these workers and to build a satisfactory health program. An excellent opportunity is provided to determine the influence of the industrial and occupational environment on health by the study of the physical condition of workers through pre-employment and periodic examinations and of rates of illness and injury and of death. Preventive and treatment services may be integrated.

Industrial plants employ a large proportion of the members of the labor force. These workers report for work each day and it is possible to obtain records of illnesses and injuries. Although the opportunity exists, little progress has been made in the United States in the study of morbidity and mortality statistics of industrial workers. The first step would be to learn the frequency of illness and injury and the death rate of these workers. Such information should be used for the development of complete industrial health programs.

Selected material relating to industrial and occupational environment and health from morbidity and mortality statistics will be used in this discussion. This paper has been divided into three sections; namely, A. Studies of Mortality Statistics, B. Studies of Morbidity Statistics and C. Summary and Recommendations.

A. STUDIES OF MORTALITY STATISTICS

As in every type of health work, we turn first to mortality

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statistics for data regarding the health of workers. Four studies, that of Dublin using industrial policy holders, the English studies, the study of mortality in the United States by Whitney, and Tennessee studies will be mentioned for the purpose of making recommendations for future analyses rather than for detailed report.

1. *Mortality of Industrial Policy Holders.* The occupational mortality experience of insured wage earners has been studied by Dublin (1) and Dublin and Vane (2, 3) for the three-year periods, 1911-1913, 1922-1924, and 1937-1939. They found that the death rates of white male industrial policy holders in the age group, 25-64 years, were higher than the rates for white males in the general population of the United States. Even after elimination for the most part of medical selection by exclusion of the experience of workers insured in the ordinary life insurance department in the last five years, they found that the death rate in 1938 of white males 20 years and over in the industrial department was 44 per cent higher than the rate for all males in the ordinary life insurance department. This excess of 44 per cent for industrial policy holders indicates a health problem of great magnitude in this group.

Because of the lack of information regarding the number of living policy holders in the different occupation groups, Dublin and Vane used the method of proportionate mortality and calculated the standardized relative index of deaths from selected causes of these industrial policy holders, age 15-64 years, for three years, 1937-1939. They were unable to find out whether different occupation groups had higher death rates from all causes than did other groups. Their analysis revealed that relatively high proportions of deaths were due to tuberculosis for occupations with exposure to silica dust; to pneumonia for welders, iron and steel foundry operatives; and to accidents for electric light and power line men, for workers in building trade, for brick and stone masons, lumber men and loggers. This method has been useful in showing occupations with hazards and these data have been extensively used by agencies con-

cerned with improvement of industrial conditions. They do not reveal, however, why the industrial policy holders have a 44 per cent higher mortality than do the ordinary policy holders. The authors recognize the need for further study by saying "Much remains to be done, however, if the death rate of wage earners is to be lowered to approximately that of the non-wage-earning group."

2. *English Studies.* We have to turn to the English for extensive and careful studies of occupational mortality. The Registrar-General of England and Wales publishes decennially occupational mortality for the three years about the census year (4, 5). The latest report (5) deals with the mortality experience in five social classes and various occupations of men, wives of these men (according to husband's occupation) and single women.

Division of the population into these five social classes is an attempt to divide persons in relation to place on social scale, with those of the lowest economic status, in Class V. Nearly half of the eleven million males were in Class III. Standard mortality ratios were used, that is, the ratios of registered to

Table 1. Standardized mortality ratios, all causes, ages 20-65 years, England and Wales,¹ 1921-1923 and 1930-1932.

SOCIAL CLASS	1921-1923	1930-1932			
	Males (Exclud- ing Non- Civilians)	Civil- ian Males Only	Males (Includ- ing Non- Civilians)	Married Women by Class of Husband	Single Women
ALL CLASSES	100	99	100	100	100
I Professional, etc.	82	87	90	81	100
II Intermediate between I and III	93	94	94	89	(64)
III Skilled Workers	94	97	97	99	95
IV Intermediate Between III and V	99	101	102	103	102
V Unskilled Workers	121 ²	112	111	113	112
Unoccupied	—	—	135	134	(122)

¹ The Registrar-General's Decennial Supplement, England and Wales, 1931, Part IIA, Occupational Mortality, Table K, page 20.

² Corrected figure.

standard deaths. Standard deaths are calculated by applying the general mortality rates of all males, all married women or all single women as the case may be to three times the population of the age groups, 20-24 years, 25-34 years, 35-44 years, 45-54 years, 55-64 years, and summing the products. They represent the deaths which would result in an occupational group if that group was exposed at each age to the standard mortality risks. The standardized mortality ratios for all causes for these five social classes are given in Table 1.

A variation in mortality according to social class from a low ratio for Class I to a high ratio for Class V is noted for males and married women. Such a variation is not apparent for single women.

Although considerable emphasis is placed on this grouping of occupations into social classes, detailed data are given by occupations according to causes of death. Data from this report would be valuable for development of industrial hygiene programs for specific occupational groups.

From these English data, I have tried to learn in which industries workers were experiencing high death rates. To tell the authorities that the professional workers have low and the laborers high death rates does not help them very much in attacking the problem (except, perhaps, indirectly through preventing poverty). The occupations have been grouped into thirty-one occupational units which indicate, to some extent, industrial classification. Laborers and certain other workers, however, have been taken out and placed in "Other and Undefined Workers." The number of workers in these units and the mortality ratios for males are given in Table 2 according to rank of ratios.

In public administration and defense, the unit with highest ratio, the defense workers in Army, Navy, Marines, and Air Force had a standard mortality ratio of 181. The second unit—a large group with over a million workers—had the high ratio of 119, due principally to the large number of laborers. Personal Service had high ratios for inn and hotel keepers, barmen,

waiters, porters, barbers and hair dressers. The next few units show types of industrial workers with high standard mortality ratios and indicate where efforts should be directed in industrial hygiene programs. If laborers and unskilled workers were studied according to industrial groups, a means of attacking their problems by industrial health workers might be provided.

3. *Mortality in United States by Occupations in 1930.* The National Tuberculosis Association appreciated the need in the United States for data relative to health risks of various occu-

Table 2. Standard mortality ratios, all causes, ages 24-65 years in 31 occupational units in order of size, with populations, England and Wales,¹ 1930-1932.

OCCUPATIONAL UNIT	POPULATION	RATIOS
Public Administration and Defense ²	297,906	128
Other and Undefined Workers ³	1,209,140	119
Entertainment and Sport	80,638	115
Personal Service	395,142	115
Bricks, Pottery and Glass	60,201	111
Painters and Decorators	222,679	108
Textile Goods and Articles of Dress	226,952	107
Transport and Communication	1,314,126	107
Mining and Quarrying	824,521	106
Precious Metals and Electro Plate	19,424	106
Textile Workers	258,925	105
Metal Workers	1,132,050	101
Workers in Other Materials	25,329	101
Skin and Leather	38,511	99
Fishermen	23,464	96
Commercial, Finance and Insurance	1,233,244	96
Warehousemen, Storekeepers and Packers	209,453	95
Non-metalliferous Mine and Quarry Products	21,899	94
Stationary Engine Drivers, etc.	143,594	94
Mixed or Undefined Materials	56,323	92
Watches, Clocks, and Instruments	16,724	91
Electrical Apparatus	154,909	90
Food, Drinks and Tobacco	142,969	90
Clerks and Draughtsmen, Typists	661,851	90
Printers and Photographers	122,889	89
Builders, Bricklayers, etc.	622,649	88
Wood and Furniture	400,456	87
Professional	326,403	83
Chemical Processes, etc.	37,024	80
Paper and Cardboard	30,995	79
Agricultural	874,001	73

¹ The Registrar-General's Decennial Supplement, England and Wales, 1931, Part IIA, Occupational Mortality Data from Table I, page 191.

² Ratio for Public Administration, 80, for Defense, 181.

³ Includes general laborers with ratio 119, laborers with ratio 166, other unskilled workers (class of work specified) with ratio 117.

pations for the guidance of industrial health authorities. They published the well-known volume, *DEATH RATES BY OCCUPATIONS*, based on data of the United States Census Bureau, 1930, edited by Jessamine S. Whitney. Data were used from death certificates of ten states in 1930 comprising 38 per cent of the population.

Perhaps the rates most frequently quoted from this report are those for tuberculosis of the respiratory system. As an example of the results of this study, the standardized death rates from all causes and from tuberculosis of the respiratory system by social-economic status are presented in Table 3.

The standardized death rates for males 15-64 years by social-economic status show wide variations similar to those of the standardized death ratios in England and Wales.

Although these data leave little doubt that the rates are higher in the semi-skilled and unskilled workers, the analysis of data without subdivision for white and negro workers raises a question regarding the influence of race. In the United States death rates from all causes and from tuberculosis are higher in the colored population than in the white population and a

Table 3. Standardized death rates from all causes and from tuberculosis of the respiratory system for gainfully occupied males in selected occupations, 15-64 years of age, ten states, according to social-economic class,¹ 1930.

SOCIAL-ECONOMIC CLASS	ALL CAUSES RATE PER 1,000 POPULATION	TUBERCULOSIS OF THE RESPIRATORY SYSTEM (RATE PER 100,000 POPULATION)
ALL IN SELECTED OCCUPATIONS	9.1	87.5
Professional Men	6.7	26.2
Proprietors, Managers and Officials	7.9	43.2
Clerks and Kindred Workers	7.8	65.8
Agricultural Workers	6.2	46.5
Skilled Workers and Foremen	8.3	72.1
Semi-skilled Workers	10.1	102.1
Unskilled Workers	14.5	184.9

¹ Whitney, J. S.: *DEATH RATES BY OCCUPATIONS* Selected Data from Table 8, page 32.

higher proportion of the colored population is of the semi-skilled or unskilled class. These data have been valuable in showing variations by occupations and indicate the need for further studies in the United States. For such analyses, division of the material by color would be helpful. The difficulties in obtaining accurate data, and in relating data from death certificates, are brought out in this study. This should serve as a beginning and efforts should be made to obtain satisfactory data on death certificates and population schedules for study of mortality. Sufficient population data should be provided for use in analyses.

4. *Mortality in Tennessee by Occupation and Industry.* Labor and other interested groups have asked the Tennessee Department of Public Health for data regarding death rates by occupation, such as those prepared by Whitney. Because of these requests and because of establishment of an industrial hygiene service which had a director who wished to know the health problem in industrial groups, occupation and industry on death certificates have been coded, using the classifications of the United States Bureau of the Census (7). Although, because of movement of population and growth of industry, the period of time was unsatisfactory for the study of mortality, a start was needed. Many factors will have to be considered in interpretation of the data. If this work serves for improvement and extension of such mortality studies, it will have served a worthwhile purpose.

One of the difficulties encountered in analysis is the lack of census data by age and occupation for the white and non-white population of Tennessee. This is a serious problem, as death rates corrected for age for white and colored males and females are needed for understanding death rates by occupation groups. Probably this lack of data was the reason such rates were not prepared by Whitney. Since totals are available, estimates have been made. It is recognized that recent changes in the population have not been taken into account in these estimates; however, the removal of physically fit young men for the Armed

Services probably does not affect appreciably these death rates. The standardized death rates from all causes and from tuberculosis for white males, using occupational groups, for three years, 1944-1946, are presented in Table 4.

Although these death rates were considerably lower than those for 1930 published by the National Tuberculosis Association, in general the same type of variation was noted with lower tuberculosis death rates for the professional workers than for the laborers. The differences in the rates, however, were not as great.

Another method of studying the data for knowledge of industrial health problems seems advisable. In our studies of absenteeism and work with industrial plants, knowledge of illness and death rates according to industrial classifications would be helpful. For example, do employees of glass companies, meat-packing plants, hosiery mills, have high or low rates? Directors of these plants wish to know the experience in other industrial plants of the same type. Also, in small plants, employees have more than one occupation and even work in different departments. For studies of absenteeism in small plants, we have not been able to study illness rates by occupations because of difficulty in getting accurate data. Rates have been calculated by departments. If it is impossible to obtain

Table 4. Standardized death rates from all causes and from tuberculosis for white males 15-64 years of age by occupational group, Tennessee, 1944-1946.

OCCUPATIONAL GROUP	ALL CAUSES RATE PER 1,000 POPULATION	TUBERCULOSIS RATE PER 100,000 POPULATION
TOTAL	6.4	61.8
Professional	6.2	26.3
Proprietors, Managers and Officials	9.2	33.9
Clerks and Kindred Workers	6.3	51.3
Farmers	4.3	56.6
Craftsmen	7.8	68.0
Operatives	10.8	93.6
Service Workers including Defense	(17.5)	(108.0)
Laborers	7.3	91.7

accurate occupation data in such studies for which data are supplied by personnel and medical departments, it seems unlikely that data from death certificates and census reports would be accurate. It is granted that, for large industrial plants, managers would be interested in data by occupation. In Tennessee in 1939, of the 2,289 manufacturing establishments, only 33, or 1.4 per cent, had more than 500 employees. These large plants had only 29.3 per cent of the employees in manufacturing industries. In the United States, the comparable percentages were 1.2 and 35.4. Thus, it is primarily with small industrial plants that a health program could best be directed. Just as we think first of total death rates of a county or city, before breaking them down by districts of the county or wards of the city, similarly we should think first of the illness and death rates of industrial plants before obtaining finer subdivisions.

The Census Bureau has recognized the increased importance of industrial statistics and has enlarged its tabulations. Fortunately, census data are available for the white and non-white populations employed and seeking work in industrial classifications.

An attempt has been made to study mortality in Tennessee according to industrial classification of the Bureau of the Census as well as occupational groups. Since the numbers of deaths in some of the groups were small, standardized death ratios, as used in the Report of the Registrar-General of England and Wales, seem preferable to standardized death rates for the study of mortality in industrial groups. In Table 5 the observed and expected deaths and their ratios are given for broad industrial groups for the same three-year period.

For the major groups, the observed and expected deaths appear to agree within reasonable limits. A slight excess was noted in a few groups which included occupations with high standardized death rates. Subdivision of the manufacturing industries into the various industrial classifications as chemical and allied products, stone, clay, and glass products; iron, steel, and their

products; etc., would be of tremendous value to our industrial hygiene service.

Although this method seems satisfactory and the results have practical value, there are difficulties to be overcome in bringing together such data from the census and from death certificates. One difficulty is evident from the comparison of observed and expected deaths for those with no occupation or industry, that is, the unemployed. An industrial classification in the census was given for only employed workers and experienced workers seeking work or 79 per cent of the white males 15-64 years of age. At the time of the census, 5 per cent were on public emergency work, 1 per cent were new workers seeking work and 15 per cent were not in the labor force. In these unemployed

Table 5. Observed and expected deaths¹ from all causes and from tuberculosis for white males 15-64 years of age according to industrial classification, Tennessee, 1944-1946.

INDUSTRIAL CLASSIFICATION	ALL CAUSES			TUBERCULOSIS		
	Observed	Expected	Ratio	Observed	Expected	Ratio
TOTAL DEATHS	14,334	14,334	1.00	1,453	1,453	1.00
Agriculture, Forestry and Fishing	3,879	4,977	.78	478	478	1.00
Mining	263	251	1.05	33	29	1.14
Construction	1,024	874	1.17	97	92	1.05
Manufacturing	1,693	1,763	.96	168	211	.80
Transportation, Conservation and Public Utilities	998	858	1.16	72	88	.82
Trade	1,508	1,499	1.01	98	162	.60
Personal Services	254	209	1.22	28	22	1.27
Professional and Related Services	382	415	.92	13	43	.30
Government (including Defense)	1,120	397	^a	64	41	^a
Other	459	481	.95	45	52	.87
Not Classifiable	1,716	171	^a	216	20	^a
No Occupation or Industry Stated	1,038	2,439	^a	141	215	^a

¹ Expected deaths have been obtained by applying the age specific death rates for white males for the three years, 1944-1946, to the estimated population of white males employed and seeking work in the industrial classifications.

^a Observed and expected deaths for these classifications are not comparable due to deficiencies in the data and conditions incident to the war.

persons 2,439, or 17 per cent, of the deaths would be expected to occur; however, only 1,038 death certificates, or 7 per cent, were of persons without occupation or industry stated on the certificates. Although this discrepancy may be attributed in part to employment incident to the war and war service, this is not the entire explanation. In 1940, the percentage of death certificates without an occupation or industry stated was approximately the same as in this three-year period. Thus, the data for occupation and industry on the census schedules and on death certificates differ considerably. Another difficulty which is our problem and can be overcome is lack of sufficient data for classification according to industry. There were 1,716 deaths, or 12 per cent of the deaths, with data not satisfactory for industrial classification. For occupations such as laborers it will be necessary to obtain the kind of industry or kind of work. This analysis has a practical value for industrial health work in Tennessee and in other states. Satisfactory statistical data should be and can be provided.

B. MORBIDITY STATISTICS

As in all fields of public health, morbidity statistics are preferable to mortality statistics for knowledge of health problems and for use in the prevention of illness and death. Morbidity is used here meaning all illness resulting from disease or injury. Little progress has been made in developing morbidity statistics for large groups of the population. Special studies, such as the Hagerstown Morbidity Studies with reports by Sydenstricker (8), the United States Public Health Service study of 9,000 families with publications by Collins (9), the National Health Survey (10), the Milbank Study of Chronic Diseases in the Eastern Health District of Baltimore (11) were undertaken as special projects and have added considerably to our knowledge of illness rates in the general population.

A practical method of obtaining morbidity statistics for the adult population employed in manufacturing plants is through the study of illnesses causing absence from work. The managers of many plants are concerned with the health problems of their

workers as evidenced by the inauguration of measures for control of occupational diseases and injuries and the establishment of medical departments. Since reporting of cases of occupational disease and injury is required in many states and compensation is usually provided by law, progress is being made in this phase of the program. As the result of the reduction of industrial hazards and prevention of occupational illnesses and injuries, the causes of illness of these workers, that is respiratory and digestive diseases, are the same common causes of illness of persons in the general population. The relative size of illness rates from these causes in a specific industry would be of great value for plant managers and industrial health workers. Without satisfactory data for a relatively large group of industrial workers, there are no standards for comparison of the experience of a plant. How frequently should we expect workers to be sick? How can control programs be developed for prevention of illness and injury? Some progress has been made in the development of such statistical data. Two types of studies, those of absences of eight days and longer and those of one calendar day and longer will be discussed briefly.

1. *Studies of Absences of Eight Days and Longer.* Gafafer of the United States Public Health Service has been releasing quarterly reports of absences from illness and non-industrial injury lasting eight days or longer. Such data are obtained for analysis from periodic reports from sick benefit associations, company relief departments and group insurance plans. This is a large experience (12) averaging in 1946, 221,442 males and 22,112 females. Although during the ten years, 1937-1946, the frequency of sickness and non-industrial injuries increased in both males and females, due to employment of inexperienced and very young employees and of older employees and the loss of young men physically fit for military service, the trend was reversed in 1946. The average annual number of absences of eight days or longer due to sickness and non-industrial injuries in 1946 was 114.5 per 1,000 for males and 248.2 for females. The release of these data currently in Public Health Reports

gives us considerable knowledge of the sickness rates of industrial workers.

2. *Studies of Absences of One Day or Longer.* Since absences of short duration occur frequently and since control measures may be effective in preventing some of these short time absences, the study of all illness and injury causing absence from work of one calendar day or longer is also valuable for knowledge of morbidity of the adult population. A public utility, Boston Edison, has kept careful medical records of its employees dating back to 1913. Information regarding absences of one calendar day or longer includes age, sex, occupation, department, social status, number of calendar and working days lost, diagnosis, etc. Sappington (13) analyzed their experience for the five years, 1918-1922 and recommended at that time the collection and analysis of "comparative data in similar industries, whereby it may be duly ascertained whether any given experience is extraordinary or commonplace." Gafafer (14) has continued the analysis of data for this public utility. Data for the last four years for which they are available by cause (1938-1941) are given in Tables 6 and 7. Comparable data for Tennessee plants for 1944-1947 are given in these tables. Because of differences in classification of causes, it was necessary to group data for presentation of the two experiences.

For knowledge of the industrial health problems in Tennessee, a study of causes of absences of one calendar day or longer was started in 1944, using reports of plants invited to participate. The combined experience of the six plants participating for a year or longer during the four years is presented.

From the frequency rates in Table 6 it is noted that, on the average, male employees were absent due to illness and injury in the public utility 0.9 times per year and in Tennessee plants 1.4 times per year. For females, the rates were higher, 1.9 for the public utility and 2.4 for Tennessee plants. A more recent report for the public utility (15) for 1940-1944 gave higher rates, 1.1 for males and 2.1 for females. These rates, however, were lower than those for Tennessee plants.

Disability rates are also available for the public utility and Tennessee plants. The numbers of days of disability per employee are given according to causes in Table 7.

Judged by frequency rates, respiratory and digestive diseases are responsible for a large proportion of illnesses of these workers and indicate fields in which preventive measures are needed. The possible reduction of absences due to influenza through use of vaccine needs to be investigated through carefully controlled studies.

Table 6. Average annual number of absences lasting one day or longer due to illness and injury, per 1,000 workers, by cause, for public utility,¹ 1938-1941, and for Tennessee plants,² 1944-1947.

CAUSE	PUBLIC UTILITY 1938-1941		TENNESSEE PLANTS 1944-1947	
	Male	Female	White Male	White Female
TOTAL	919.7	1,851.2	1,413.3	2,429.7
<i>Illness, Total</i>	854.5	1,765.8	1,316.0	2,335.1
Infectious and Parasitic Diseases	10.1	8.1	22.5	28.8
Diseases of Eyes and Ears	12.2	20.7	17.6	32.2
Diseases of Nervous System	20.2	56.1	9.2	20.6
Diseases of Circulatory System	19.1	23.2	17.8	15.9
Diseases of Respiratory System	540.7	946.3	635.7	957.6
Influenza	148.6	169.5	99.7	123.8
Other Respiratory Diseases	392.1	776.8	536.0	833.8
Diseases of Digestive System	153.7	324.4	227.6	362.3
Infected and Impacted Teeth	17.0	37.8	32.2	67.8
Other Digestive Diseases	136.6	286.6	195.4	294.5
Diseases of Genito-Urinary System	11.3	147.2	12.6	338.0
Dysmenorrhea	—	123.6	—	284.5
Other of Genito-Urinary System	11.3	23.6	12.6	53.5
Diseases of the Skin	13.4	21.5	30.6	25.8
All Other Diseases	49.9	88.6	14.4	31.7
Ill-Defined and Unknown Causes	24.0	129.7	327.8	522.1
<i>Injuries, Total</i>	65.3	85.4	97.3	94.6
Industrial	22.4	4.5	29.1	15.8
Nonindustrial	42.8	80.9	68.2	78.8

¹ Data for Public Utility taken from MANUAL OF INDUSTRIAL HYGIENE, chapter 24, by W. M. Gafafer, page 427. Number of person-years of exposure: males, 10,826; females, 2,460.

² Number of white males, 10,316 and white females 5,962.

The investigation (16) of absenteeism due to illnesses due to dental diseases in Tennessee is an example of the use which has been made of such data. Although the dental caries rate was relatively low in Tennessee, the absence rates due to dental causes were higher than the comparable ones from the public utility. It was believed that this condition in industrial workers was the result of an accumulation of dental defects without corrections and lack of dental service. The dental service available in Tennessee was found to be limited, with one dentist per 3,932 population. A conference of leaders in industrial

Table 7. Average annual number of days of disability per person due to absences from illness and injury of one day or longer, by cause, for public utility,¹ 1938-1941, and for Tennessee Plants, 1944-1947.

CAUSE	PUBLIC UTILITY 1938-1941		TENNESSEE PLANTS 1944-1947	
	Male	Female	White Male	White Female
TOTAL	8.23	11.91	7.72	12.79
<i>Illness, Total</i>	7.09	10.66	6.91	12.29
Infectious and Parasitic Diseases	0.33	0.17	0.29	0.61
Diseases of Eyes and Ears	0.12	0.15	0.09	0.13
Diseases of Nervous System	0.52	0.55	0.14	0.26
Diseases of Circulatory System	0.79	0.57	0.25	0.41
Diseases of Respiratory System	2.77	4.42	2.98	4.27
Influenza	1.01	1.10	0.73	0.99
Other Respiratory Diseases	1.76	3.32	2.25	3.27
Diseases of Digestive System	1.18	1.51	1.23	1.91
Infected and Impacted Teeth	0.05	0.13	0.14	0.22
Other Digestive Diseases	1.13	1.39	1.08	1.69
Diseases of Genito-Urinary System	0.36	0.79	0.17	1.54
Dysmenorrhea	—	0.29	—	0.57
Other of Genito-Urinary System	0.36	0.49	0.17	0.96
Diseases of Skin	0.15	0.24	0.26	0.18
All Other Diseases	0.76	1.57	0.24	0.74
Ill-Defined and Unknown Causes	0.12	0.69	1.27	2.24
<i>Injuries, Total</i>	1.14	1.25	0.81	0.50
Industrial	0.68	0.04	0.30	0.14
Nonindustrial	0.46	1.21	0.51	0.36

¹ Data for Public Utility taken from *MANUAL OF INDUSTRIAL HYGIENE*, chapter 24, by W. M. Gafafer, page 427.

dentistry, in dental profession, in industrial hygiene, and in public health was held for discussion of this problem. Recommendations were made regarding development of industrial dental health programs.

There are other causes, such as infectious and parasitic diseases, diseases of eyes and ears, diseases of genito-urinary system, which are higher in Tennessee than in the public utility and need further study. The collection and analysis of causes of absences have definite value in determining illness rates and are useful in evaluating the experience of a given plant.

In the field of cancer control it is possible that data regarding causes of illness might reveal that certain industrial environments play a role in the causation of cancer. According to Hueper (17) there are good reasons for assuming that the majority of carcinogenic agents is still unknown, unknown types will be discovered and occupational cancers will become a public health problem of the first order. For learning the effect of the production or handling of carcinogenic agents on the health of workers, study of illness rates for a large employed population would be of value.

Sufficient data are not available for the study of the effect of industrial and occupational environment on health. A large study with such data from many plants and from various sections of the United States would provide morbidity statistics for developing sound preventive and treatment programs for the maintenance of good health of industrial workers.

C. SUMMARY AND RECOMMENDATIONS

1. Dublin and Vane's study of mortality of industrial policy holders revealed death rates 44 per cent higher than for ordinary policy holders. The proportions of deaths due to certain causes in certain occupation groups were high, indicating problems. Their work has shown the need for study of death rates from all causes by specific industrial or occupational groups. They recommended the compilation of mortality by causes of workers engaged in different occupations by the National Office of Vital Statistics.

2. The English studies have revealed occupations with high mortality rates and the great variation in mortality by social class. Instead of analysis by social status, a more practical approach to the problem would appear to be through study of mortality ratios for different kinds of industries and occupations within industries. Such data would be valuable for industrial plant managers and medical departments by providing definite information regarding problems.

3. The study of occupational mortality in 1930 in ten states by Whitney has shown the variation by social-economic class and that death rates are high in certain occupational groups. This work should be used as a beginning and ways should be developed whereby data on death certificates can be related to data on population schedules and satisfactory analyses made for the United States.

4. The study of death rates in Tennessee has revealed many problems. Census data for the white and non-white workers were not available by occupation groups by age. The need for developing comparable data for occupations and industries on death certificates and on census schedules was apparent. It is strongly recommended that steps be taken to insure satisfactory studies for the period of the 1950 census, preferably for three years, 1949-1951. A practical approach for providing usable statistical data for industrial health workers is through the preparation of death rates by industrial classifications. Because of the small numbers in age groups, it is suggested that standardized death ratios be considered for use in analysis.

5. Studies of frequency of illness and injury and disability from these causes have been developed, with a large experience for plants with records of absences lasting eight days or longer and with a limited experience for plants with records of absences of one day or longer, such as for a public utility and for Tennessee plants. Analyses of absenteeism are of value for the plants, for industrial health workers and for those concerned with the health of the population. To provide sound morbidity statistics for adult populations, it is recommended that the study of

illnesses and injuries of one day and longer be extended. Standards need to be developed with the same type of analysis, using frequency and disability rates for many plants. A research project—perhaps properly included as one in public health methods—could be undertaken either in the United States Public Health Service or as part of the research of a School of Public Health or by a Foundation for development of satisfactory morbidity statistics and for use of these data for knowledge of the influence of the occupational and industrial environment on health and in improving industrial conditions. It is possible that the excess in mortality of industrial workers can be reduced. Such data are needed for the development of sound health programs for maintenance of good health of industrial workers and for extension to the entire population.

REFERENCES

1. Dublin, L. I.: Causes of Death by Occupation. *United States Bureau of Labor Statistics* Bulletin No. 207, Government Printing Office, Washington, 1917.
2. Dublin, L. I. and Vane, R. J.: Causes of Death by Occupation. *United States Bureau of Labor Statistics*, Bulletin No. 507, Govt. Printing Office, Washington, 1930.
3. Dublin, L. I. and Vane, R. J.: Occupational Mortality Experience of Insured Wage Earners. Extract from the *Monthly Labor Review*, June, 1947, 64, No. 6, Govt. Printing Office, 1947.
4. THE REGISTRAR-GENERAL'S DECENNIAL SUPPLEMENT, England and Wales, 1921, PART II, OCCUPATIONAL MORTALITY, FERTILITY, AND INFANT MORTALITY. London, His Majesty's Stationery Office, 1927.
5. THE REGISTRAR-GENERAL'S DECENNIAL SUPPLEMENT, England and Wales, 1931, PART IIA, OCCUPATIONAL MORTALITY. London, His Majesty's Stationery Office, 1938.
6. Whitney, J. S.: DEATH RATES BY OCCUPATIONS. New York, National Tuberculosis Association, 1934.
7. United States Department of Commerce, Bureau of the Census: ALPHABETICAL INDEX OF OCCUPATIONS AND INDUSTRIES. Government Printing Office, Washington, 1940.
8. Sydenstricker, E.: A Study of Illness in a General Population Group; Hagerstown Morbidity Studies No. 1. *Public Health Reports*, September 24, 1926, 41, pp. 2069-2088. For papers II-XII see *Public Health Reports*, 1926-1929.
9. Collins, S. D.: Variation in Hospitalization with Size of City, Family Income, and Other Environmental Factors. *Public Health Reports*, Oct. 30, 1942, 57, pp. 635-1659 (Includes references to other papers of this series).
10. National Health Survey: List of Publications, *Public Health Reports*, May 29, 1942, 57, pp. 834-841.

11. Downes, J. and Collins, S. D.: A Study of Illness Among Families in the Eastern Health District of Baltimore. *Milbank Memorial Fund Quarterly*, January, 1940, xviii, pp. 5-26.
12. Gafafer, W. M.: Sickness Absenteeism Among Male and Female Industrial Workers, 1937-1946, Inclusive. *Public Health Reports*, Oct. 24, 1947, 62, pp. 1538-1541. For other reports see *Public Health Reports*.
13. Sappington, C. O.: A Five Years' Sickness and Accident Experience in the Boston Electric Illuminating Company of Boston. *Journal of Industrial Hygiene*, July, 1924, 6, pp. 81-101.
14. Gafafer, W. M.: *MANUAL OF INDUSTRIAL HYGIENE*. Philadelphia, W. B. Saunders Co., 1943.
15. Gafafer, W. M. and Sitgreaves, R.: The Age Factor in Disabling Morbidity, 1940-1944, Experience in a Public Utility Company. *Public Health Reports*, Dec., 7, 1945, 60, pp. 1447-1462, Reprint 2680.
16. Puffer, R. R. and Sebelius, C. L.: Absenteeism in Tennessee Industrial Plants Caused by Diseases of the Teeth and Gums. *Journal of the American Dental Association*, Sept., 1946, 33, pp. 1122-1131.
17. Hueper, W. C.: The Significance of Industrial Cancer in the Cancer Problem. *Cancer Research*, 1947, 7, 37 (Abstract of Papers Presented at A.A.A.S. Gibson Island Research Conference).

THE PLACE OF NUTRITION IN THE RELATIONSHIP BETWEEN ENVIRONMENT AND HEALTH

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IN THE relationship of environment to health and welfare, nutrition occupies a key position. For, many environmental factors, inside as well as outside the body, exert influences upon nutrition which it in turn reflects in health and welfare. As an intermediary, it is at once a clearing house and relay system. To show its strategic position, as well as its complex and intricate nature, let us first take an inventory of its known relationships demonstrated from data on man. For with full acknowledgement of underlying animal studies for their vast accumulation of knowledge upon which the science of nutrition was erected, its ultimate acceptance and application depended upon demonstration in man.

In many minds diet is so closely associated with nutrition that often the terms are used interchangeably with complete confusion from lack of distinction between them. Nutrition is a bodily process; diet refers to a regimen of food which supports nutrition. Over the past decade particularly, computations on food production and imports have yielded data on per capita consumption of foods (1). Numerous diet surveys in their various forms and determination of levels of nutrients in blood have revealed dietary patterns in terms of foodstuffs or their component nutrients (2, 3). From the results of these inquiries, valuable generalizations have been drawn. Even with standards set so low that few would dispute their decisiveness, a substantial prevalence of unsatisfactory diets has been recorded. Furthermore, interesting regional differences appear both in the prevalence of deficient diets and in the nature of the inadequacies. That economic forces influence the diet is well-known. For one thing, in general the nutritive quality of the diet varies with the income level. The poorest diets and greatest percentage of poor diets are found in lowest income groups. Then too, when low incomes remain stationary with

increase in cost of obligatory items in the budget, such as rent, the allotment for food suffers. Contrariwise, when low incomes are raised, families reflect the favorable change in their fortunes by an upward shift in the character of their diet. In some instances it has been shown that within the family, food was not distributed among its members according to their needs; the mother spared others and fared worst.

Data with an even closer bearing upon the problem have come from surveys of nutritional status with identification of malnourished persons. After physical measurements had been abandoned because they were not sufficiently sensitive, accurate, or comprehensive, and biochemical determinations of the concentration of nutrients in the blood had likewise been rejected because they reflected, not nutritional status, but dietary intake, appraisal from clinical signs was adopted (4). While controversy has raged over the association of these signs with specific nutrients, most observers agree at least that they are related to nutrition. Surveys have revealed an appreciable proportion of malnourished persons: exactly how many has depended on where the scale was set (2). As in dietary pattern, the worst nutritional status and the highest percentage of poor status are found in the lowest income groups. What at first was surprising but upon reflection became understandable, the proportionate prevalence and severity of the signs of malnutrition increased with age (4).

After the collection of data on dietary intake and clinical signs of deficiency states, the second stage in the epidemiological approach to malnutrition in its natural setting was the attempt to demonstrate association between the two sets of data. One successful example is noteworthy because it comprised a disease that had not yet been established as having a deficiency origin. Within a limited radius Goldberger, Wheeler, and Edgar Sydenstricker demonstrated differences in food supply and incidence of pellagra that were related (5). But the method of correlations has its limitations in proof of etiology. If a positive association is found between two sets of data, it does not necessarily

indicate a causal relationship; if the association is suggestive of a causal nexus, it does not point out which member is cause and which is effect; if one element is identifiable as the cause, it is not necessarily the only cause. Appreciating these points Goldberger turned to the experimental production of pellagra and its cure for demonstration of its nutritional character. But this example is not typical of the data or kind of correlation applied to it today. For one thing it comprised extremes in diet and deficiency disease. Particularly, it should be noted that pellagra represented a somewhat fully-developed, florid deficiency state. Then too, correlation was sought between pellagra and diet, not a particular component of the diet.

Present-day attempts start with the assumption that prevalence of dietary deficiency in a particular nutrient and clinical signs attributed to it should show positive correlation. With some exceptions, this expectation has proved disappointing. Evidence indicates that under certain limited circumstances, it is obtained. But for the most part, there is no association. Two possibilities appear. Shortcomings in the collection of data and use of equivocal standards in the dietary survey; and subjective differences in observation and standards in clinical appraisal may have vitiated the results. Or, secondly, rather than reject the results of attempted correlation because they do not substantiate a preconceived notion, it might be better to accept them and scrutinize the basis of the conflicting assumption. Comment here will be restricted to this latter approach because its range of influence not only covers much of the first, but goes far beyond it.

It is indeed helpful to note the particular procedure of inducing deficiency states and the type of resulting diseases which helped to mold the traditional prevailing concepts of their cause and nature; for quite understandably they led to the erroneous assumption that short-term dietary data and nutritional status should of necessity exhibit a positive correlation. The view on etiology was derived from experiments in which deficiency diseases were induced in animals by subjecting them unremittingly

to a diet nearly totally deficient in a nutrient. Animals were plunged into a deficiency state. The only variable studied and allowed to differ between groups was diet. All other environmental variables were minimized or equalized and therefore ignored. When this procedure with animals is compared with the free operation of many factors on man in his environment, there are more points of difference than similarity. The deficiency disease produced in animals by this procedure was analogous to the florid type traditional in clinical medicine, but not to other forms beginning to be recognized. Could these concepts of the character of a deficiency disease and its production be inadequate?

By integrating observations on their pathology, signs, and response to therapy, it has been possible to create a broader concept of the character and course of deficiency states that takes in all the facts (6). In its essentials it points out that deficiency states are characterized by three quantities: speed, intensity, and stage. In speed the deficiency process may be acute or chronic. Although finer divisions are recognizable, according to the simplest classification, it may be mild, moderate, or marked in degree; and it may be early, intermediate, or advanced in stage. Time which appears in both the speed and duration of a deficiency state is an important element in this concept. Actually, the acute form in man is an exacerbation. It is a transitory episode arising out of the chronic and subsiding into it. It does not persist since it either leads to death or most frequently disappears. Its dramatic character imparts to it an importance out of all proportion to its prevalence. In contrast, the chronic is persistent and basic since it underlies the exacerbation. The chronic, furthermore, is the most prevalent type. It should be emphasized that the tissue changes in the acute and chronic forms of a deficiency state occur in the same sites but are different in pathology. Significantly, many signs of the chronic type have been regarded in the past as signs of aging. This concept of deficiency states, particularly its element of time, explains in large part why

positive correlation between diet intake and clinical signs is obtained only under narrowly limited circumstances. Time is required for the effects of poor diet to be manifested in tissue pathology. As a corollary, diet may change quickly either improving or worsening without absolute concurrent change in tissue pathology. Most importantly, on the other hand, tissue manifests cumulative as well as contemporaneous pathology. Naturally the cumulative pathology bears no necessary comparable relation to the dietary record during a particular limited period. Further, the concept explains the recorded differences in diagnosis, prevalence, and therapeutic response. Most important, it opens new vistas of investigations in medicine.

The prevalent view of etiology has been simple: faulty diet causes deficiency disease. But this doctrine, reflecting mostly one source of data, has never been sufficient to cover all instances; and upon closer scrutiny it becomes apparent that it does not embrace all the components in any instance. It has long been known that other factors than diet affect nutrition. In 1866, long before the nutritional character of pellagra was recognized, Roussel pointed out that the efficient cause had to be in conjunction with a set of conditions for production of that disease (7). McCarrison, in 1921, in his book *STUDIES IN DEFICIENCY DISEASES* devotes a chapter to Factors Influencing the Onset of Morbid States Due to Food Deficiency (8). As the list of these items has meanwhile been extended, they have been variously designated but today most commonly as conditioning factors (9). But, because it has been difficult to relate many of them to diet, it has been equally difficult to place them in the existing etiological scheme; consequently, they have been treated as something separate and apart. The result has been a narrow, disjointed view of etiology, never an inclusive, integrated system.

I should like to present briefly a new concept of the etiology of deficiency states (10) that accommodates all the seemingly divergent aspects. (Fig. 1.) Tissue nutrition in respect to the biologically active form of any nutrient depends upon the ratio

**FOR THE BIOLOGICALLY ACTIVE
FORM OF A NUTRIENT**

$$\frac{\text{SUPPLY TO TISSUE}}{\text{TISSUE REQUIREMENT}} = \text{NUTRITIVE BALANCE}$$

Fig. 1. Ratio determining nutritive balance of a tissue in respect to the biologically active form of a nutrient.

of $\frac{\text{tissue supply}}{\text{tissue requirement}}$. At any given time, the just previous tissue status \times the ratio = current tissue status. All the external and internal environmental factors that influence either or both members of the ratio in whatever direction are conditions, a precise yet shorter term for conditioning factors. (Fig. 2.) These exceedingly numerous conditions may be conveniently classified according to their natural location and character which have, however, no necessary bearing on the manner in which they act upon the ratio. (Fig. 3.)

Conditions that increase the numerator or decrease the denominator tend toward making the ratio favorable; those that operate oppositely conduce to an adverse ratio. (Fig. 2.)¹ In a broad, loose sense, an adverse ratio and the combination of conditions responsible for it comprising a complex can be regarded as the cause of the resulting deficiency state in the tissue and its ensuing pathology. But in the interest of clarity and precision in delving into the etiological system, a distinction should be drawn between the ratio and the conditions. The adverse ratio is the primary, direct, immediate cause of the tissue deficiency process; while the combination of conditions influencing the ratio to that end are secondary, indirect, mediate causes. Most

¹ Parenthetically, it should be noted that for some nutrients the ratio has an optimum zone above which as well as below which it is adverse. For example, a supply of lipogenic nutrients in excess of requirements would be conducive to obesity.

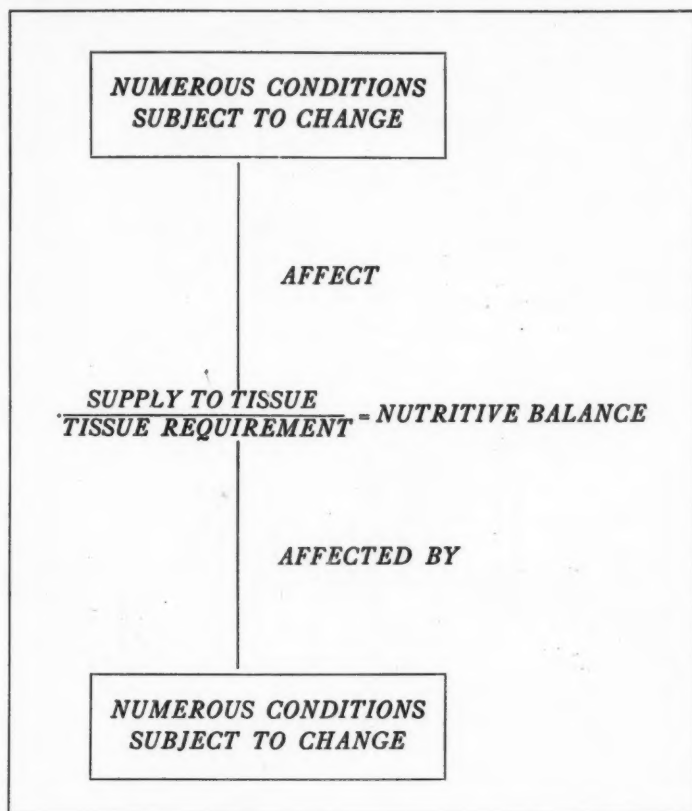


Fig. 2. Action of conditions on members of ratio determining nutritive balance.

simply and accurately designated, the adverse ratio expressing deficiency is the cause; factors responsible for its unfavorable level are adverse conditions. These conditions are a prerequisite to its existence and continuation as well as a qualification determining its alteration or cessation.

Several features of this etiological system merit comment. One is the dynamic behavior of the ratio. Conditions capable of change are constantly exerting influence on it. Another charac-

CLASSIFICATION OF CONDITIONS

1. *External Environment*
 - a. *Socio-Economic*
 - Living conditions
 - Working conditions
 - Available foods
 - Ability to seek them
 - Income
 - Education
 - b. *Physical and Chemical*
 - Radiant energy
 - Light, infra-red
 - Ultra-violet, x-ray
 - Radioactive
 - Temperature
 - Mechanical
 - Trauma
 - Physical movement
 - Pressure; irritation; friction
 - Occlusion
 - Dentures
 - Toxicants
 - c. *Dietary*
 - 1) Form of nutrient
Provitamin: analogue
Potential or intrinsic biological activity
 - 2) Level
 - 3) Imbalance—
Disproportion
 - 4) Interrelations
 - a. Protein-Carbohydrate-Fat
 - b. Vitamin-Vitamin
 - c. Vitamin {
Protein
Carbohydrate
Fat
2. *Bodily Environment*
 - a. *Digestive and Metabolic Channels*
 - Functional form of nutrient
 - Appetite
 - Ingestion
 - Digestion
 - Absorption
 - Transport
 - Formation of enzyme
 - Breakdown of enzyme
 - Elaboration } Metabolism
 - Utilization }
 - Storage
 - Metabolic level
 - Excretion
 - Biosynthesis
 - Intestinal synthesis
 - Biodegradation
 - Intestinal destruction
 - b. *Functions and Reactions*
 - Degenerative
 - Disease {
Neoplastic
Organic
Toxic
Infectious
 - Chemotherapy
 - Endocrine relationship
 - Nutritional status
 - Morphology and physiology of tissue
 - Growth
 - Pregnancy
 - Lactation
 - Work
 - Psychobiology
 - Food habits
 - Psychosomatic reactions
 - 5) Inhibitors—Antagonists
Anti-vitamins
 - 6) Enzymatic destruction
 - 7) Autoxidation-rancidity
Oxidants-autoxidants
 - 8) Processing of foods
 - 9) Availability of nutrients
Precipitation
Phytic acid—Iron
Oxalic acid—Ca
Palatability
 - 10) Acceptability—

Fig. 3. Classification of conditions affecting the ratio according to their natural location and character. The list is not exhaustive.

teristic is the multiplicity of conditions in action at any one time. Some are continually in operation; others are occasional. It is the net effect of the aggregate that determines the quotient. Never is one solely responsible for an adverse ratio. Thirdly, since not only the cast of conditions but also the degree of influence of any condition may change from time to time, the etiological complex exhibits relativity. At any one time, the influence of each adverse condition is relative; at another time the relative influence of each adverse condition in the composite may have changed. Fourthly, expressing a dynamic process, the ratio is characterized by velocity, intensity, and duration, which it derives from the resultant of many conditions and imparts to the tissue. Here again, time through its inherence in velocity and duration is an element in etiology as it is in the resulting pathological process in the tissue.

To clarify what is meant by conditions and how they influence the ratio, it might be helpful to cite a few familiar examples of them and their effect on the development or accentuation as well as on the subsidence of deficiency states. (Fig. 3.) A gastro-intestinal disorder may impede absorption and transport of nutrients and thereby interfere with supply to the tissues. Decrease in supply diminishing the quotient of the ratio tends to a deficiency state. With abatement or disappearance of the adverse condition, supply and the resulting quotient would increase unless other unfavorable conditions intervened with counteraction.

Acting on the other member of the ratio, growth, pregnancy, and physical labor are conditions conducing to deficiency states by raising the level of requirements. It is a byword that young animals subjected to an incomplete diet must grow if they are to develop acute deficiency states. Growth makes exacting and unyielding nutrient demands which reduce the quotient and accentuate the deficiency state. Arrest of growth with consequent lowering of requirements changes the denominator in the opposite direction. As another example, signs of deficiency states may flare up during pregnancy. That an increase in nu-

trient requirements is associated with pregnancy is generally accepted; this increase in the divisor of the ratio, operates adversely towards reducing the quotient. With the termination of pregnancy, its effect on the ratio ceases; its particular aliquot of the divisor drops out.

In historical accounts it is recorded that among sailors with scurvy, hard work often precipitated collapse. Conversely, a pellagrin put to bed, even though continuing to eat a pellagra-conducive diet, shows remission for a time. Here the lowering of requirements from reduced activity is tantamount to nutrient therapy; for reducing the denominator has the same mathematical result as increasing the numerator. It should be noted too that conditions differ in their efficiency of exercising influence on the ratio. Although it may seem odd, it is nevertheless true that bed-rest is nutrient therapy in highly effective form.

In all three examples, growth, pregnancy, and work, the recognition of increased requirements associated with them is evidenced by larger recommended dietary allowances. The attempt is to increase supply to counterbalance the increased requirements. But to repeat, although each of the three conditions may precipitate an aggravation of deficiency states, it should not be concluded that any of them alone can bring it about. Unless other adverse conditions, such as inferior diet, disease or pre-existing poor nutritional status prevail, growth, pregnancy, or physical exertion does not set off deficiency signs. Of the aggregate of adverse conditions contributing to an unfavorable ratio, one is usually decisive in the sense that it adds enough to tip the scale. It is, however, not necessarily the major adverse force; rather its timing attracts disproportionate attention to it.

At the risk of seeming to minimize diet, whereas the intent is to bring the ensemble of conditions in proper perspective in which neglected members are elevated to their rightful place, it should be pointed out that poor diet is not the cause of a deficiency state but a condition conducive to it. Poor diet alone

cannot produce a deficiency state; for it is never the sole condition in operation—other conditions intrinsically participate. Deficiency states may even occur when diet is satisfactory and therefore operating favorably on the ratio. True, in many, if not most, instances of deficiency disease, poor diet is the major adverse condition; but in other instances, it is a minor condition. Sometimes deficiency disease occurs when diet is not an adverse condition.

Besides these more familiar examples, the list includes several conditions less commonly recognized as related to nutrition. Mechanical stress, a general term covering many specific situations, is a condition affecting the nutrition of tissues. It may be recalled that one of the usual signs of scurvy in the infant is subperiosteal hemorrhage in the thigh, a site of considerable movement. Contrariwise, when the hind leg of a guinea pig on a scurvy-conducive diet is immobilized, acute changes do not occur (11). Similarly, it is probable that movement of the tongue, one of the most active organs in the body, contributes to the acute glossitis of pellagra. In a kindred category is pressure, such as occurs in dental occlusion. In its more severe form of malocclusion even greater pressure is applied on fewer points of contact. It then becomes understandable why the severest changes in gingivitis of avitaminosis C are often located at these sites. Ill-fitting dentures in their effect on the gums and angles of the mouth fall in the same category. Another type of condition apt to be overlooked is radiant energy. Intense light or glare aggravates or elicits photophobia and lacrimation in persons affected with ariboflavinosis. Conversely, confinement to a dark room or use of dark glasses is a temporary expedient minimizing an aggravating condition. It should be repeated that they are conditions, not causes; that they affect the nutrition of tissues; and that each may contribute to a deficiency state but alone is not responsible for it.

Two of the most influential adverse conditions are infection and existing poor nutritional status. Twenty-five years ago it was vigorously debated whether xerophthalmia was an infection

or a deficiency disease. Careful histopathological studies settled the issue: xerophthalmia was shown to be a deficiency disease in which infection usually supervened (12). Other deficiency states have now been observed to conform to the same pattern. At a certain stage in their development, secondary infection of the tissue is almost invariable. As a condition, not a cause, infection aggravates and accentuates existing pathology. Also especially noteworthy among the list of conditions is existing nutritional status. If the tissue is already the site of deficiency pathology, usually chronic, its requirements obviously are raised. One of the outstanding reasons that an acute deficiency sign may be induced in one study but not in another is the initial difference in the nutritional status of the subjects.

Far-reaching as are the implications of this concept, they do not exceed the facts. At the least, this concept with its multiplicity of conditions and its element of time helps to clarify why a positive correlation between diet intake and prevalence of deficiency states is usually not obtained. What is more important, it brings out the relationship of the many environmental conditions, both external and internal, to nutrition. It also explains the character and course of deficiency processes and their prevalence. It bears directly upon the assignment of cause in diagnosis and influences views on dietary requirements. But its greatest import comes from the realization that the possibility that a disease of unknown cause may be nutritional in nature is not to be forthwith dismissed because it apparently is not the effect of dietary deficiency alone; rather this contingency can be examined on broader etiological grounds.

It has been demonstrated that many conditions, among them growth, pregnancy, and health, affect nutrition. But whether there is a reverse relationship, a reciprocity of nature, in which nutrition influences these functions of life has been a transcendent question. Studies with animals on these relationships have yielded a decisive and convincing affirmation; but before acceptance of this applicability to man the prerequisite of evidence from human studies has properly been interposed.

From surveys of university students in Boston and Toronto (13) it was found that cohorts with average age of 18 years had gained nearly 2 inches in height over 15 years during a period which started with the beginning application of the newer nutritional knowledge. It has been shown repeatedly—Mann, Orr, and McCollum were among the first to bring forth evidence—that children eating a poor diet and already retarded in growth gain in height and weight upon receiving supplementary food of high nutritive value (14). As for nutrition and childbearing, results from studies in four localities, Philadelphia (15), Toronto (16), Boston (17), and England (18) have led to substantially the same conclusion: the nutrition of a gravid woman influences the course of her pregnancy and parturition; and the status of the newborn. If this condensed statement seems to underrate the importance of its message, it is no exaggeration to declare that it points to the single greatest new measure for prenatal care.

On a vaster scale intimations have come from England on the influence of nutrition on health. One source was a controlled study of mass migration in which part of a population moved from slum dwellings in Stockton-on-Tees to a modern housing estate, while a second comparable group remained (19). For the five years subsequent to moving, the transferred population had an increase of 46 per cent over its previous mortality rate; while the group remaining in the slum dwellings showed a reduction. When the expenditures of the two groups were compared, it was found that the transferred population allotted a lower percentage of its budget for food because of its higher rentals. The report states: "It is difficult to come to any other conclusion than that the increased mortality was associated with the dietary deficiencies."

Using data of national magnitude, Magee accredits nutrition with the improvement in the public's state of health in the United Kingdom during wartime (20). He writes: "A diet more than ever before in conformity with physiological requirements became available to everyone, irrespective of income.

The other environmental factors which might influence the public health had, on the whole, deteriorated under the stress of war. The public health, so far from deteriorating, was maintained and even in many respects improved. The rates of infantile, neonatal, and maternal mortality and the stillbirth rate reached the lowest level ever."

Valuable as is the existing body of knowledge for immediate application, it is equally worthy for opening new avenues of exploration which may bring further rewards to public health. It is becoming increasingly clear that nutrition is a much more complex, far-reaching, and influential force than has generally been admitted. More conditions are now recognized as affecting it; while its many, wide spheres of influence are coming to be appreciated. With it all, promising lines of investigation beckon.

For one thing, the effect of conditions on nutrition might well be more intensively studied. For example, more knowledge about the influence of hormones on nutrition might be expected to bring benefits to man. Then too, certainly high on the agenda for investigation is the important set of postulated relationships: nutrition in its effect on physical performance, fatigue, psychological functions, congenital deformities, immunity and resistance to infectious diseases, aging, and longevity. In some instances preliminary evidence holds forth promising prospects (21, 22, 23, 14). It need scarcely be mentioned that the plan and execution of studies on such questions are beset with pitfalls. Here concepts of deficiency states and their etiology are helpful guides. It is no accident that many of the studies on man thus far yielding positive results were conducted for a somewhat longer period than has been the custom in the past, though still not long enough.

Equally stimulating is the virtually virgin field of study on the possible relation between nutrition and diseases of unknown cause. One lead is at hand for exploring this labyrinth. Consider that the fully-developed deficiency diseases affect many bodily tissues, systems, and sites; and that the pathology of the chronic form is different from that of the acute, although

the sites are the same. Thus far study of the chronic form of each deficiency state has only reached the sites of early change. Certainly it is reasonable to expect that the sites of later change in the acute process have their chronic counterpart. But they are now unstudied. Even this list might well be found to be in need of amplification. In truth, there should be further study directed towards a complete catalogue of tissues, systems, and sites affected in deficiency states. It should be borne in mind, moreover, that the so-called typical sequence in the procession of signs simply reflects the influence of that combination of conditions most frequently prevailing. A shift in emphasis among this combination of conditions may bring about accentuation of a late, out of all proportion to that of an earlier, sign. Furthermore, a less usual condition may aggravate an unusual site producing an atypical sign. For example, a chronic deficiency state and a supervening impairment of cerebral circulation together with contributory conditions may be conducive to encephalopathy, without acute signs of pellagra elsewhere, yet with response to niacin. Or an existing chronic deficiency state and an added endocrine disorder, together with other adverse conditions, may bring about an abdominal hemorrhage actually on the basis of a vitamin C deficiency. A table of systems and sites affected in deficiency diseases would show many open spaces for the chronic form which continued study might be expected to fill.

On the other hand, consider that medicine abounds in chronic disorders of unknown etiology. Their essentially chronic nature is especially significant. It should also be noted that the new concept of integrated conditions influencing the ratio in nutrition covers wide latitude. Hence, neither in nature nor cause would it be incompatible for chronic diseases now of unknown etiology to be nutritional. Clues on possible relations might be obtained by referring the systems and particular sites affected in these chronic disorders to the table showing the expected distribution of lesions in chronic deficiency states. Here again, because of the chronic nature of the diseases, only prolonged

studies will provide valid information. But for each identification, nutrition would gain an expected syndrome; chronic disease, a known etiology; and social medicine, a triumph.

In conclusion, both in retrospect and prospect, nutrition is seen to signalize the influence of environment on health and, as the crucial medium between them, to occupy a paramount position in that system.

REFERENCES

1. Food Consumption Levels in the United States, Canada and the United Kingdom. Report of a Special Joint Committee set up by the Combined Food Board. Issued by the United States Department of Agriculture, War Food Administration, Washington, D. C., April, 1944.
2. Inadequate Diets and Nutritional Deficiencies in the United States. Bulletin of the National Research Council, No. 109, Washington, D. C., 1943.
3. Stiebeling, Hazel K.: Adequacy of American Diets. *Journal of the American Medical Association*, March 13, 1943, 121, pp. 831-838.
4. Kruse, H. D.: Medical Evaluation of Nutritional Status. *Journal of the American Medical Association*, February 20, 1943, pp. 584-591; February 27, 1943, pp. 669-677.
5. Goldberger, Joseph; Wheeler, G. A.; and Sydenstricker, Edgar: A Study of the Relation of Diet to Pellagra Incidence in Seven Textile-Mill Communities of South Carolina in 1916. *Public Health Reports*, March 19, 1920, 35, pp. 648-713.
6. Kruse, H. D.: A Concept of Deficiency States. *The Milbank Memorial Fund Quarterly*, July, 1942, 20, No. 3, pp. 245-261.
7. Roussel, Théophile: *TRAITÉ DE LA PELLAGRE ET DES PSEUDO-PELLAGRES*. Paris, J. B. Baillière et Fils, 1866, p. 517.
8. McCarrison, Robert: *STUDIES IN DEFICIENCY DISEASE*. London, Henry Frowde and Hodder & Stoughton, 1921, Chapter iv.
9. Jolliffe, Norman: Conditioned Malnutrition. *Journal of the American Medical Association*, May 29, 1943, 122, pp. 299-306.
10. Kruse, H. D.: A Concept of the Etiological Complex of Deficiency States with Especial Consideration of Conditions. (In press.)
11. Follis, R. H., Jr.: Effect of Mechanical Force on the Skeletal Lesions in Acute Scurvy in Guinea Pigs. *Archives of Pathology*, 1943, 35, pp. 579-582.
12. Mori, S.: Primary Changes in Eyes of Rats Which Result from Deficiency of Fat-Soluble A in Diet. *Journal of the American Medical Association*, July 15, 1922, 79, pp. 197-200.
13. Porter, G. D.: Freshmen Grow in Stature. *University of Toronto Monthly*, December, 1937.
14. Kruse, H. D.; Bessey, O. A.; Jolliffe, Norman; McLester, J. S.; Tisdall, F. F.; Wilder, R. M.; and Sydenstricker, V. P. W.: Principles Underlying Studies of Nutrition Pertaining to the Influence of Supplements on Growth, Physical Fitness, and Health. *Archives of Internal Medicine*, October, 1944, 74, pp. 258-279.
15. Tompkins, W. T.: The Significance of Nutritional Deficiency in Pregnancy. *The Journal of the International College of Surgeons*, April, 1941, 4, pp. 147-153.

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16. Ebbs, J. H.; Tisdall, F. F.; and Scott, W. A.: The Influence of Prenatal Diet on the Mother and Child. *The Journal of Nutrition*, November, 1941, 22, pp. 515-526.

17. Burke, B. S.: Nutrition—Its Place in Our Prenatal Programs. The Milbank Memorial Fund *Quarterly*, January, 1945, 23, No. 1, pp. 54-65.

18. Nutrition of Expectant and Nursing Mothers. Interim Report of the People's League of Health. *Lancet*, July 4, 1942, II: pp. 10-12.

19. McGonigle, G. C. M. and Kirby, J.: POVERTY AND PUBLIC HEALTH. London, Victor Gollancz, Ltd., 1936, pp. 108-129.

20. Magee, H. E.: Application of Nutrition to Public Health: Some Lessons of the War. *British Medical Journal*, March 30, 1946, p. 475.

21. Warkany, Josef: The Importance of Prenatal Diet. The Milbank Memorial Fund *Quarterly*, January, 1945, 23, No. 1, pp. 66-77.

22. Perla, David and Marmorston, Jessie: NATURAL RESISTANCE AND CLINICAL MEDICINE. Boston, Little, Brown & Company, 1941, 1344 pp.

23. Sherman H. C.: THE SCIENCE OF NUTRITION. New York, Columbia University Press, 1943, 253 pp.

RURAL HEALTH PROGRAMS IN DIFFERENT NATIONS¹

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WIDESPREAD discussion of measures for improving rural health services in the United States suggests the possible value of exploring the undertakings of other nations in this field.

THE RURAL HEALTH SITUATION

We have become concerned about the special problems of rural health and medical care in the United States with increasing intensity over the last ten years. Some recognition of a special rural health problem can be traced, at least, to the pre-Civil War period when, in the report of the first Commissioner of Agriculture to President Lincoln, a chapter was devoted to the health problems of farm families (1). As urban medical facilities improved and as physicians and other medical personnel increasingly settled in the cities, the acuteness of the rural health problem became increasingly appreciated. In 1911 the first department of public health was organized for a rural county—in Yakima County, Washington. Around 1920, rural communities of New England began to take organized steps to attract physicians, through providing them subsidies and housing facilities (2). In 1933 the first organized measures were taken by the federal government to make personal medical services more readily available to farm people, through the prepayment medical care program of the Farm Security Administration. In 1946 legislation was passed designed above all to improve the medical care facilities in rural areas—the National Hospital Survey and Construction Act (3).

In countries throughout the world there has been this same recognition of the special problems of rural health and the need for special measures to attack them. In general, an apprecia-

¹ Address before the National Home Demonstration Council, October 8, 1947, at Jackson's Mill, West Virginia.

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tion of rural health problems has come about earlier abroad than in the United States, commensurate with earlier industrialization and hence earlier evidence of the sharp disparity between urban and rural health resources. In all nations the development of scientific medicine and the promulgation of public health and sanitary measures have been initiated in the cities, leaving the rural areas for a long time to get along as best they could. Everywhere certain "natural benefits" have been attributed to life in the country and, at the same time, students of public health have increasingly pointed out that rural health conditions are not so rosy as abundant fresh air and sunshine might lead one to expect.

Dr. René Sand of the University of Brussels, one of Europe's foremost leaders of public health and social medicine, writes:

These (public health) services exist now, in more or less complete form, in the large towns. They are too often non-existent in rural districts, where hygiene is neglected to such an extent that, in spite of the hygienic advantages of the country, its mortality often exceeds that of the towns. . . . In France and Belgium, half the population lives in municipalities unprovided with a water supply, two-thirds have to go without drains, without service for the removal of domestic refuse, without medical notification of births and deaths, and without the aid of a public health nurse (4).

In countries where little industrialization has taken place, the attack on the health problems of the entire nation has been, in effect, a task of rural medicine and rural public health. Such is the case in the tropics, where colonial powers have been called on to face the tremendous problems of reducing or wiping out malaria, dysentery, African sleeping sickness, hookworm disease, elephantiasis, schistosomiasis, and scores of other diseases that result from extreme lack of proper sanitation or housing (5). It is probably fair to say that the problems of so-called "tropical medicine" are not so much the result of temperature as of poverty. In nations like China or India, where teeming millions live at a bare subsistence level, we find

tremendous problems of infectious and hunger diseases which, in other nations at the same geographic latitude, have been wiped out or materially reduced primarily through improvements in the general standard of living. In the Orient tens of thousands of people die every year from cholera and in Africa from yellow fever. These are rural health problems which make our own look mild by comparison.

It is in the more industrially advanced nations that we find closer parallels to the tasks of rural medicine and public health faced in the United States. For in such nations the diseases resulting from bad sanitation do not loom so large that they obscure all other health problems. In other words, in the more industrially developed nations health leaders have been faced with the task of bringing day-to-day medical care to rural people, as well as the preventive measures of environmental sanitation. The relative shortages of medical personnel and facilities in the rural sections of such nations have stimulated the promotion of numerous special programs to bring medical care to peasants and other country dwellers, through government action (6). It may help us a little in facing the problems of rural health and medical care in the United States to review briefly some of the highlights of these rural health programs in other parts of the world.

RURAL PUBLIC HEALTH

First we may consider organized efforts in the field of public health. The province of public health activity has had varied definitions at different times and places. In all countries public health activity has taken its origin in the attack on contagious diseases (7), but in many it has broadened to a sphere considerably beyond that which is practiced in the United States. In the rural areas particularly, many foreign nations make their public health agencies responsible for the provision of medical care to the general population or, at least, to large sections of the population. In this country we look upon the prevention of scarlet fever, for example, as a responsibility of the health

department, but the treatment of a case of scarlet fever is regarded as the proper responsibility of a private physician. In Norway, the public health officer in a rural district is expected to treat cases of scarlet fever and other communicable diseases as well as to prevent them. At the same time he provides medical care in any illness to low-income people who cannot afford to buy it privately. Dr. Karl Evang, the Director-General of Health in Norway, describes the functions of a rural public health officer as follows:

In the central districts of Norway a public health officer is in the great majority of cases a physician who within a definite, comparatively limited district has an extreme duty and a great responsibility. He represents not only the central medical administration in his district but is also charged with the task of being sanitation and hygienic superintendent, of looking after medical-judicial affairs and of directing enterprises for the safeguarding of health. Along with all this he also serves as a practising physician in his district. The major part of his working time is not spent in any office but round about in the district, in direct contact with the people. He is paid by the State for his hygienic and administrative work, but in reality also directs the local Board of Health within his district. Besides his income from the State, he also enjoys income from activity as a practising physician. On a single trip through his district it may well happen, for example, that he first treats a patient for a bone fracture, then meets with the Board of Health to decide to isolate a case of contagious tuberculosis, then inspects sanitary conditions in a slaughter house, then undertakes physical examinations of school children, thereafter performs a post-mortem and finally meets with one or several of the voluntary health organizations to plan the further extension of infant-care stations (8).

The broad functions of public health officials in the Scandinavian countries are not confined to the health officer. The public health nurses in rural areas of Sweden, for example, give a great deal of their time to the nursing care of the sick, as well as to the health educational and preventive activities which absorb practically all of their time in this country (9).

In our neighbor to the north, especially in the western Canadian provinces, public health activities are likewise very broadly defined. In Alberta, for example, under the health department, there are medical clinics that travel through the rural districts and provide diagnosis and treatment for many illnesses at a small charge, varied in accordance with the patient's means. In this province also, infantile paralysis is treated through the resources of the health department without expense to the patient. The same applies to all cases of cancer, for which the health department has organized a network of surgical, x-ray, and radium services. Hospitalization for maternity cases is likewise a responsibility of the health department, financed out of general revenues (10).

In some nations, considerable responsibility for what are here regarded as public health functions has long been assigned to voluntary agencies in rural areas. This is the case in Italy, for example, where tasks like tuberculosis control, venereal disease control, and maternal and infant hygiene are assigned to private societies that receive grants of public money to carry on their work (11). In Holland, there has been a growing system of so-called "Cross" organizations with similar functions since about 1870. In that year, the White Cross was organized to provide home nursing services in the rural districts. Later a Green Cross organization was set up and today about half the population of Holland is served by either the White-Yellow Cross or the Green Cross, depending on religious affiliations.

The Dutch Cross organizations represent a combination of what we would call a voluntary prepayment plan and a county public health agency. In order to obtain services from one of the local Cross organizations, a rural dweller must pay a membership fee which varies from the equivalent of \$1 to \$4 per year depending on income. This membership entitles the family to home nursing services and to the loan of nursing and medical supplies in the event of sickness. If a baby is to be born, for a small fee the Cross will furnish a midwife and afterwards a special obstetrical housekeeper-aide (known as a

"baker") who will do the housework as well as care for the baby in the post-partum period. The Cross organization likewise operates baby and pre-school child health centers in rural districts. In some localities, it enters the schools to supervise the health of school children. As in Italy, these agencies are subsidized to as much as two-thirds or three-quarters of their cost by different levels of government, and the government protects its investment by appointing members to various committees which help formulate operating policies (12).

Among the South American countries, public health services are advanced in Chile perhaps more than anywhere else. In that greatly spread out nation, the problems of rural public health have been tremendous and the government has looked upon their solution as one of its major political tasks. The pattern of health work is very similar to that which we carry on in this country, but one device is unique and deserves special mention. This is the requirement that all persons covered by the Chilean social insurance system (which we will discuss later) should receive a periodic medical examination once a year, designed especially to eradicate or minimize tuberculosis, syphilis, heart disease, and occupational diseases. Since farm laborers are covered in the Chilean program, this provision has its beneficial effects in rural areas (13).

Although the special problems of rural public health have been faced throughout the world, perhaps earlier in some places than in the United States, it is widely recognized that much remains to be done to bring rural preventive services up to their urban level. In 1931 the League of Nations held an International Conference on Rural Hygiene, in which many recommendations for the expansion of public health services for rural districts were made. Great emphasis was placed on the need for education of the people, for the training of rural public health personnel, and for the construction of rural health centers (14). There is no question that the present World Health Organization, associated with the Social and Economic Council of the United Nations, will likewise devote much of its

efforts to the advancement of rural public health services throughout the world (15).

MEDICAL PERSONNEL FOR RURAL AREAS

The relative dearth of doctors and other health workers in rural areas has been even greater in most foreign countries than in the United States. There are nations like China or pre-revolutionary Russia in which the concentration of the available doctors in the cities has been so overwhelming that millions of rural people have simply never seen a doctor. The severity of the problem, combined perhaps with certain psychological factors, have for some years led to organized measures to bring doctors and related personnel to rural areas in nations throughout the world.

In Sweden, for example, the problem has been attacked directly by government through imposing responsibility for general medical care on the official health officer. There are three types of doctors in Sweden: the private practitioner, the hospital physician, and the public health officer (16). Most rural people get their medical care from the so-called "provincial doctor" who serves as health officer and is on government salary, but who may charge small fees if the patient can afford to pay. If an individual must go to the hospital, he is treated by a hospital doctor who is nearly always on salary from the local or national government. In order to attract men to the position of provincial doctor in a rural area, the local government often provides not only medical facilities but also a home in which to live (17).

In China the problem of personnel is so enormous that the present government is setting up a system of completely socialized medicine, in which virtually all doctors serving the millions of agricultural people will be on government salary and have combined responsibilities for medical care and public health (18). This is the current practice, indeed, for the native populations of Puerto Rico, the Virgin Islands, and the British West Indies, although the supply of public medical practitioners is quite inadequate. The great problem in regions like China,

India, or most of Africa is the task of training enough doctors to meet the needs. Once the doctors and other personnel are trained, their distribution to rural areas will be simpler than in this country, since medical care will be provided as a direct government service.

Action by a national government to provide medical personnel for rural people has been taken along different lines in Scotland. In northern Scotland the thinly settled country presented a special socio-economic problem for many years, leading in 1913 to the establishment of the now well-known "Highlands and Islands Medical Service." A special grant was made by the British Parliament to the Department of Health for Scotland, in order to subsidize doctors and nurses who would settle in this low-income area. Each year private doctors who are willing to practice in the area receive a special government stipend, plus an allowance for the travelling necessary to reach the scattered families. In addition, the doctor may charge small private fees in accordance with the family's ability to pay. Nurses are provided through nursing associations which receive grants, in addition to the funds they derive from charity and private fees. Grants are given to community councils in the area to build or improve houses for the doctor to live in. Hospitals are likewise subsidized and in recent years it has been possible to bring specialists into the area through the same device (19).

It is to be noted that under this program the rural doctors remain private practitioners although they are financially assisted by government. It is hoped in the future to integrate the activities of these practitioners with local public health functions in the area. Through the Highlands and Islands Medical Service more and better medical care has undoubtedly been made available to these rural people. A government investigation of the program some years ago concluded:

In contrast with what existed before the Fund was set up, it can now be said that there are no districts that cannot obtain a doctor's services on reasonable terms. . . . With the guarantee

of a reasonable minimum income to the doctor in these areas, a much better class of practitioner is being attracted. . . . The result is that there has been a marked improvement in the general standard of the medical service available. . . . To encourage men to keep abreast with developments of medical science, arrangements have been made to enable a limited number each year to obtain the benefit of a post-graduate course of study (20).

In western Canada subsidies to maintain physicians in rural areas have been provided by units of local government for many years. The provinces of Saskatchewan and Manitoba are divided into so-called "rural municipalities," (each with a population of 2,000 or 3,000) somewhat analogous to our rural townships. About 1921, a few rural municipalities of Saskatchewan decided to use tax funds for paying a fixed annual salary to any doctor who would settle in the area (21). For this he would be expected to render general medical services to the entire population, but an extra fee could be charged for special procedures. The pattern spread and today there are nearly 100 rural municipalities and some 60 villages covering 203,000 people, that are assured of a doctor's services through this pattern. A somewhat smaller number are found in Manitoba and Alberta (22).

Our neighbor to the south, the Republic of Mexico, likewise has taken some interesting steps to obtain medical personnel for rural areas. In Mexico medical education is financed entirely by the government so that many rural young people, who would otherwise not be able to afford it, can be trained as physicians. A government regulation requires that every graduate must serve a so-called "period of social service" in a rural community for at least one year following his hospital internship. These rural externes practice under the direction of a district public health official, but they render general medical care to the people of one or more rural villages. In this way rural people are provided with services, the young doctors gain valuable experience, and many graduates are attracted to settle in the rural district permanently (23).

The nation that is always in the news these days, Soviet Russia, has taken some interesting steps to maintain medical personnel in rural districts. Dr. Henry E. Sigerist, the distinguished scholar of world medicine and formerly of The Johns Hopkins Medical School, describes the Soviet practice as follows:

I remember an interview with the People's Commissar of Public Health of the Ukraine on a hot summer evening of 1938. I told him that in the United States we found it difficult to persuade well-trained young doctors to practise in rural districts and asked him what their experience had been. For a while he failed to see the point and did not understand why this should present a problem. He came from a farm family himself and said that the majority of the medical students of the Ukraine came from farms and studied with the intention of returning to the farms. As a matter of fact talented young people are frequently delegated to a medical school by their collective farms which defray all their expenses while they are studying in the city. The reasons that rural practice is not unattractive to Soviet doctors are easy to find and can be summarized in a few points.

The Soviet country doctor does not depend for a living on the per capita spendable income of the population he serves. Being salaried, he is economically independent. His salary is larger than that of a city doctor of equal position and experience, because his task is more difficult and his responsibility greater. Like all medical workers he enjoys all benefits of social insurance.

The erection of rural medical centers with hospital and laboratory facilities permits the country doctor to practise scientific medicine, the kind of medicine for which he has been trained in medical school. Besides having one month's vacation every year, the rural physician attends every three years a postgraduate course of at least three months, either in regular medical schools or in special postgraduate schools. During that period he receives not only his salary but also a special allowance. The country doctor thus keeps in constant touch with medical developments. After graduation almost all young physicians spend three years in rural practice as part of their general training.

This gives them an all-round experience after which they may return to the city if they so choose but many remain in the country. This part of the training program brings a constant stream of young physicians into the rural districts (24).

In most foreign countries steps have been taken to make health services available to rural people through the extensive training of auxiliary personnel. In nations with an over-all shortage of physicians, this has been the most practical way to provide at least a minimum level of service promptly—that is, without waiting for the twenty or thirty years necessary to train an adequate supply of doctors.

Much has been done along these lines in South America. In Peru, for example, a number of so-called "sanitary inspectors" have been trained to render minimal services in the villages along the Amazon and other rivers. These personnel are trained in a short course given in Lima. They learn the rudiments of sanitation and personal hygiene and the simplest ways of recognizing and treating major hazards of the jungle country, like malaria, hookworm disease, tuberculosis, yaws, and accidents. In the isolated villages these health workers promote sanitary practices and handle the common disease problems, but difficult cases are referred to doctors who come periodically on "dispensary launches." The sanitary inspectors themselves travel from village to village by canoe (25).

The same general type of pattern is followed in many parts of Africa. Dr. Clement C. Chesterman of the Belgian Congo was in the United States recently and described the valuable services rendered by simply trained but devoted "native practitioners" in Central Africa. Dr. Chesterman has prepared a handbook of general medicine and minor surgery which is used widely by these rural assistants (26).

In more socially advanced countries auxiliary medical personnel are also widely used in rural districts. Chile makes much use of briefly trained practical nurses and midwives; they work in rural areas under the direction of a doctor who makes periodic visits (27). In Russia there has been widespread use of medi-

cal aides known as "feldshers" since as long ago as 1860. These rural workers are somewhat analogous to our public health nurses, but they have considerably more latitude in their work, doing minor surgery and obstetrics as well as prescribing drugs for common illnesses. After the Soviet Revolution, elimination of the feldshers was considered, but instead they were given improved training and put under the supervision of district physicians. Thus, pending the training of more physicians, rural villages are furnished with at least limited medical services by these feldshers, most of whom incidentally are men, without the people having to travel long distances to an urban center (28).

In New Zealand there is an especially interesting class of auxiliary health practitioner making services available to rural and urban people alike. This is the so-called "school dental nurse." These health workers are not simply dental hygienists in the sense that we use the term, but serve as full-fledged dentists providing services to school children throughout the nation. They are mostly young women trained in a three-year course at government expense, subsequently becoming employees of the national government. They render dental care that is complete (that is, including prophylaxis, fillings, extractions, and related services) except for prosthetic work and orthodontia to all school children whose families say they are unable to pay a private dentist. Reports on this program indicate that the quality of dental care is excellent and the quantity of services is considerably higher than that received generally by rural children in this country (29).

A vital and unique system of training auxiliary health workers in rural districts was set up some years ago in Yugoslavia at Zagreb. The school of public health there trains health officers, sanitarians, and nurses. But it also provides short courses in hygiene for peasants. The system has been described as follows:

Peasants from the villages come, men for a course of five months, women for three months. They are housed in special quarters

provided by the school, and during the course they are given instruction not only in public health but in history, geography, economics, and agriculture. Back in the villages, these peasants become the pioneers of health, the health conscience of the village. They instruct and advise their fellow peasants and are the most valuable co-workers of the health officers. They know the local conditions best and know better than any doctor possibly could where help is needed most urgently. . . . The School also organizes courses in homekeeping for women in the villages during the autumn and winter months, and during such a course the peasant women are taught the elements of hygiene (30).

MEDICAL FACILITIES FOR RURAL PEOPLE

In the provision of physical facilities for medical care in rural areas, nations throughout the world have taken public action even more than in the provision of personnel. The preponderance of hospitals under voluntary or private control in the United States—and especially in rural America—is a feature almost unique among nations. In most lands throughout the world, hospitals and other medical facilities are predominantly controlled and financed by national or local governments. As a result of the financial support implicit in such arrangements, rural people have enjoyed special benefits.

The pattern of governmental hospitals is particularly well developed in the Scandinavian countries. In Sweden more than 90 per cent of all general hospital beds are owned and operated by the national government or the authority of the province or commune. In the nation as a whole there are reported to be 4.2 beds in general hospitals per 1,000 population, which may be compared with a national average in this country of about 3.3 beds per 1,000. The best supplied province (Uppsala) has 5.2 general beds per 1,000 and the most poorly supplied province (Norrbotten) has 2.6 beds per 1,000. Even in the poorest rural districts of Sweden the hospitals are fully utilized, since their services are financed almost entirely out of government funds and social insurance. Thus, the Swedish population is hospitalized at a rate ranging from 1.02 to 1.63 days per person per year in the different provinces, without counting days spent in out-

of-province hospitals (31). Average utilization in the United States is under one day per person per year and in the predominantly rural states it was only about 0.65 days per person per year in 1940.

The same general situation obtains in Norway and Denmark. In Denmark in 1942 there were 4.8 beds per 1,000 population in general hospitals, not counting the beds in small infirmaries, private physician clinics, maternity homes, and tuberculosis and mental institutions. The utilization was 2.12 days per person per year (32). In all three Scandinavian countries, physicians are permanently attached to the hospitals on government salary, so that the patient does not have expensive surgical or medical fees to pay. With this system there is a certain loss of continuity between the treatment of the patient by his family doctor and his care in the hospital. The hospital physicians, on the other hand, become highly skilled in the various specialties and as a rule they make full reports on cases to the family doctor who will see the patient when he returns home.

In the Scandinavian countries likewise, hospitals have long been planned to form a regional network of which we have heard so much in the United States in the last few years. A Danish article, describing the recent hospital construction legislation in the United States, comments that this measure puts the United States in the position where Denmark was in 1806 (33). Whether or not this is an exaggeration, the fact is that little Denmark has made great progress in its regional hospital development, designed to assure services for rural people. Danish hospitals have been operated by county and borough councils for many decades, but the regional pattern was launched in 1912 when the means of transportation were considerably improved. Then, instead of simply building more hospitals in the rural villages, a system of so-called "central hospitals"—one or two per county—was developed. Difficult cases from the small rural hospitals are sent to the central hospital for special services. In Copenhagen there is a large institution which serves the entire nation with the most advanced services.

In most of South and Central America hospitals likewise are operated and financed predominantly by the government, treatment being free to all who cannot pay. They are operated by the national, state, or municipal units and some are exclusively for persons covered under the social security system. The number of beds is actually far below the needs and in rural areas the problems are particularly acute (34). On the other hand, we do not find in Latin America the paradox we see in this country of rural hospital beds remaining empty in the face of vast unmet needs, simply because rural people cannot pay the price to use them.

A few years ago I visited Newfoundland and was impressed with the modest though effective hospital arrangements in that none-too-prosperous fishing and lumbering country. Most of the population of Newfoundland is peppered along the periphery of the island, settled in small villages. At intervals along the coast, there are what the local people call "cottage hospitals," subsidized by the central government and partially financed by a head tax on all persons in the locality. Attached to each hospital is a physician whose salary is financed in the same way. All persons coming to the hospital are treated without charge whether they receive bed care or out-patient care. The doctor may charge extra fees, however, for services in the home. Difficult cases may be sent to a public hospital maintained in the capital at St. John's, but there is need for development of somewhat more advanced hospital facilities outside of this single center.

It is interesting to observe how throughout the world, nations have arrived at the concept of regional hospital planning as the answer to rural needs. Everyone recognizes that rural people are entitled to the same specialized services as urban people and yet small rural communities cannot sustain complex facilities by themselves. The obvious solution is to take advantage of modern transportation to carry the difficult cases to distant urban centers and yet to make available small rural hospitals in the locality for the care of common conditions. In connection with

its new national health legislation, Great Britain has designed especially promising regional hospital plans.

As a corollary of regional hospitalization, there has grown up throughout the world the concept of the rural health center. The functions of a health center vary in different nations, but the common denominator everywhere is that of a physical facility from which preventive services are distributed to the entire population and therapeutic services for certain conditions or for certain population groups. It is somewhat like the parallel of a hospital in which people are served before they are forced to go to bed, with the pervading emphasis on the prevention of disease. Yet, in some nations, the health center is expected to contain a small number of hospital beds for limited types of conditions. Even in the United States the concept of the health center is highly variable from section to section, although the emphasis here is on limiting its functions to those of the health department alone (35).

Dr. René Sand of Belgium lists the wide variety of functions which health centers serve in different nations. They provide facilities for infant welfare stations; tuberculosis and venereal disease control clinics; immunizations; pre-natal and post-partum clinics; mental hygiene; offices for the medical officer of health; the district nursing service; public assistance services; voluntary social and health agencies; laboratories; dental clinics; and eye, ear, nose, and throat clinics; beds for contagious diseases and maternity cases; x-ray and ultraviolet therapy; and first-aid stations. Also included under the broadest conception of a health center is the provision of public baths and a laundry, a gymnasium, a day and night nursery, and a canteen. Sand says that health centers having various combinations of these functions, if not all of them, have been developed in Canada, England, Belgium, France, Poland, Latvia, Czechoslovakia, Hungary, Yugoslavia, Bulgaria, Roumania, Spain, Germany, Austria, Turkey, Palestine, and China (36).

In the reports of many nations it is difficult to distinguish actual accomplishments from proposals for future action. In

Yugoslavia, however, through the work of the great public health leader, Dr. Andrija Štampar, some 123 rural health centers were established in the years before the Second World War. The Yugoslavian concept has been to provide a health center for each rural district of about 15,000 inhabitants, with an attendant staff of a full-time, salaried physician, public health nurses, and sanitarians. In Yugoslavian villages, the health centers provide public baths and kitchen facilities for preparing meals for children. They serve also as social centers for the community. The physician is not limited to administrative services but treats sick people as well (37). It is a fitting tribute to Dr. Štampar that he has been made the Chairman of the Interim Commission of the World Health Organization.

Chile has made progress in the establishment of health centers and 519 are reported to be operating in rural areas. Not all of these are attended by a full-time physician, but they usually have a resident midwife or an apothecary and are visited periodically by travelling medical specialists and dentists (38). Other nations of South and Central America have done likewise and all have plans for using the health center as the central device for bringing medical care and public health to rural areas (39). During the war period considerable progress was made in the Central American countries through the technical and financial assistance of the Institute of Inter-American Affairs. An American physician who worked on this program in Nicaragua for three years recently indicated that he never found in the United States the deep gratefulness for the provision of health services that he found among the village people of Nicaragua. The task to be done to reduce the infectious and filth-borne diseases in Central and South America is still enormous.

As might be expected in a socialized economy, rural medical services in the Soviet Union are rendered almost entirely through health centers. Virtually all physicians practicing in rural areas are attached to health centers. The vast Soviet territory is divided into districts known as "zemstvos," some-

what like our counties. In each zemstvo is a district health department under which is a "Director of Rural Medical Services." He is located in a health center which contains medical, surgical, and maternity divisions and has full-time specialists in these fields. There is a pharmacy and an ambulance service also attached to the district center. Branching out from this center directly into the villages and collective farms are "medical stations," each serving on the average a few hundred people. To these stations are attached feldshers, nurses, and midwives, but the stations serving larger numbers of rural people have a physician on the staff. In any case, frequent visits are made to the outlying stations by the specialists from the district health center. The district center sets the standards and supervises the work of the outlying stations. The work of the district centers, in turn, is supervised by larger medical centers associated with medical schools in the chief cities of each region (40).

The British colonies in South Africa have recently made important progress in the development of health centers. There, in each magisterial district of the Transkei, is a "District Surgeon" and under him are rural clinics attended by native nurses (41). Dr. John B. Grant of the International Health Division of the Rockefeller Foundation believes there is much we can emulate in this country from the South African experience, especially the use of nursing personnel attached to health centers in areas under-supplied with physicians (42). The closest parallel to such a pattern we now have in this country has been the federal program of health services for migratory farm workers, under the United States Department of Agriculture (43). In the Republic of Turkey a "Ten Year Health Plan" is being launched which will aim to provide one health center for each forty villages. It is intended that the medical officer in charge should be responsible for the total health of all the residents of his district. In addition to being a center for all the usual preventive services, the Turkish health center will be designed, in the words of the Ministry of Health and Social Welfare, to "treat any disease encountered during the fulfillment

of the . . . preventive services to the extent of the capacity and competence of the institution" (44).

A remaining type of health facility especially designed for rural areas is the mobile unit. With our relatively good highways and advanced development of the automobile industry, we have made considerable use of such units in this country. The functions of mobile clinics, however, have generally been rather narrow, being confined to venereal disease control, dental care for children, hookworm eradication, or the like. Mobile clinics in other nations like Canada, the Soviet Union, the South American republics, and China have had broader functions, providing dispensary service for all illnesses that may afflict rural people.

A related type of service, the airplane ambulance, has been developed further in foreign nations than in the United States. The Swedish Red Cross provides such service on a regular basis. Airplane ambulances are operated as a routine feature of the Scottish Highlands and Islands Medical Service. Missionary groups in Australia carry on such service for range people in the hinterlands. The new Cooperative Commonwealth Federation (CCF) government of Saskatchewan provides airplane ambulance service for the rural people on the province's thinly settled plains, especially for those in the cold northern territory. Helicopters operated by the United States Coast Guard occasionally perform ambulance duty for fishing families on the desolate beaches of Cape Hatteras off the coast of North Carolina, but this type of rural health facility has been used relatively little in the United States.

MEETING THE PROBLEM OF FINANCING MEDICAL CARE

The underlying problem in the provision of medical care to rural people in all nations has been the method of financing. The real reason why personnel have been lacking and facilities deficient in rural areas has been that agricultural people throughout the world have been relatively poor and unable to meet the cost of scientific medical care. When public hospitals have been constructed in rural areas, serving the people without

charge, or when officially salaried physicians and nurses have rendered service to agricultural people, this has been, in effect, a method of financing medical care through the tax funds collected by a province or nation. In addition to such measures, however, there have been other methods of financing medical care in rural areas that lighten the burden on the individual through group action. Most important have been what we in the United States call group prepayment plans.

The first voluntary insurance plans for spreading the risk of medical care costs were started in the Middle Ages as a function of the workmen's guilds. At first these guilds set up mutual benefit funds for providing indemnification against loss of income in periods of disability; later the costs of medical care itself were insured. Outside of the bourgs and towns, when most rural people were attached as serfs to some feudal estate, medical care of a sort was provided through the grace of the lord of the manor (45). Today we see a kind of derivation of this pattern in the system of plantation medicine for the agricultural workers in the Territory of Hawaii (46).

As the voluntary insurance societies in the cities developed with the industrialization of our society and as medieval serfdom died out, the pattern of group prepayment spread to the countryside. Various cooperative societies for the group financing of medical care developed among peasants and rural dwellers in European countries, therefore, years before programs of government sponsored insurance were written into law. Even when compulsory social insurance legislation came to characterize the financing of medical care in Europe, these rural medical cooperatives retained their autonomy in many nations.

In Yugoslavia before the war, we had an example of rural health cooperatives still operating without any official relation to the compulsory system of social security for the industrial workers of that nation. There were in Yugoslavia in 1936 some 115 rural health cooperatives with some 57,000 members. Many of these cooperatives owned and operated their own small health centers and they employed some eighty-five physicians.

Because the peasants were poor, the cooperatives gave limited service and some of them were kept alive only because of charitable grants from philanthropic foundations in the United States, especially the Milbank Memorial Fund (47). Cooperatives among rural people reached an especially high state of development in the Scandinavian countries.

Then in the late 19th century the principle of group financing of medical care was taken over by the government and we had the birth of the modern conception of social insurance. The first national legislation along these lines was enacted under the administration of Bismarck in Germany in 1883. It is interesting to recall that Bismarck was the leader of the Conservative Party and that compulsory insurance for the costs of medical care and disability was introduced earlier than old age and unemployment insurance, since it was regarded as less controversial and closer to the hearts of the people (48).

All through Europe and in countries influenced by Europe, like Australia and Japan, the conception of government responsibility for the assurance of medical care to the population gradually expanded (49). The systems of compulsory medical care and disability insurance set up by government did not sweep aside the voluntary insurance societies, that had been doing the job in the past, but rather built upon them, assigning them many official administrative responsibilities (50). At first the compulsory features of the legislation applied only to limited segments of industrial workers, but gradually compulsory coverage was extended to agricultural laborers as well. The slowness in encompassing agricultural workers in these health insurance programs was due largely to administrative difficulties in making periodic collections of premiums from them, although the lack of political pressure from agricultural labor, in contrast to that from industrial labor, also undoubtedly played a part.

To overcome the administrative difficulty, country after country made use of the so-called "stamp plan" for collecting contributions. This is simply a device whereby the employer

of farm workers buys social security stamps in a post office and pastes them in a small book, carried by the farm laborer, after a certain period of employment of that individual. The cost of the stamps is actually borne partly by a deduction from the farm worker's wages and partly by the employer himself. When the stamp book is filled, it is sent in to the government as evidence that this farm worker is duly covered under the social security system, and a new book is issued. The presentation of an up-to-date book by the farm worker is evidence that he is entitled to insurance benefits. This system saves the agricultural employer the job of keeping records and makes possible accurate information on a hired farm worker, no matter how much he moves about for employment. Through various modifications of this device, agricultural and horticultural workers are provided some type of social insurance benefits in at least sixteen countries including: Belgium, Bulgaria, Chile, Costa Rica, Czechoslovakia, France, Germany, Great Britain, Hungary, Italy, Netherlands, New Zealand, Peru, Spain, Sweden, and Uruguay (51). This information is as of early 1945, and the extension of social security measures throughout the world has been so rapid since the end of the war that it is probably out-dated by now.

Two countries, France and Hungary, have special independent systems of social security for agricultural workers. In France this is administered by the Ministry of Agriculture and covers also the French "metayers," analogous to our sharecroppers (52). The scales of payments and benefits are somewhat different for agricultural workers from those for industrial workers in view of their lower income levels. In Holland a special law was passed in 1922 extending workmen's compensation protection to agricultural workers (53).

It is to be noted that social insurance for medical care relating to persons engaged in agriculture applies mainly to agricultural workers or employees rather than farm operators. Up to the end of the Second World War, it appeared that no nation except New Zealand encompassed all farm operators under a

strictly compulsory health insurance system. This did not mean, however, that self-employed farmers in other foreign countries could not enjoy insurance protection for medical costs. In many countries they could voluntarily join the same local insurance society which the farm laborer was required by law to join. Thus, in Denmark the majority of independent farmers are insured for medical care through voluntary enrollment in a so-called "friendly society" (54). In fact, the Danish health insurance scheme is almost compulsory, since farm operators are compulsorily covered for invalidity insurance and the way to comply with this requirement is to join a local society offering medical care benefits at the same time. The voluntary societies in Denmark, as in many other nations, are subsidized by the government and accordingly subject to public supervision.

The voluntary insurance societies are ordinarily required to provide a minimum set of benefits for persons encompassed in the social security program. These benefits vary in different countries. In England, for example, they have included disability payments in the event of sickness and cash benefits for maternity. Payments for general practitioner medical care and drugs, as a matter of fact, are directed by the Ministry of Health, without going through the friendly societies. In addition to these required basic benefits, the different societies may furnish supplemental benefits, if the members are willing to pay for them. A society of rural workers in Scotland, for example, offered in 1939 supplemental medical care benefits consisting of dental services, maintenance in and travelling expenses to the hospital, surgical care, obstetrical care, home nursing, and the services of a convalescent home (55). In 1942 there were in Great Britain twenty separate rural approved societies which had formed a federation with a membership in England and Scotland of 400,000 persons (56).

Even imperial Japan set up a system of autonomous voluntary health insurance societies in the towns and villages in 1938. All householders of small income were eligible to join these, and the prefectural governors in some sections were permitted to

make membership compulsory (57). It may be especially interesting to health officials in the United States that the administrative supervision of these village insurance programs is carried out largely by public health nurses.

There is not space to go into the details of operation of these health insurance programs in foreign nations as they affect rural people. A few essential points may simply be made. For one thing, under all the programs the patient's free choice of doctor is protected—to the extent that more than one doctor is available—and the physician still can carry on his work as an independent practitioner. Only the payment of the doctor's bill or the hospital bill is controlled by a governmental plan. For another, despite the things we sometimes read, the medical profession appears to be generally satisfied with the insurance system and criticisms are leveled only at some details of administration, coverage, and remuneration (58). Thirdly, the general trend of events has been toward continual expansion, rather than contraction, of the benefits and coverage of all the programs. Finally, there seems to be considerable evidence that agricultural people covered by these programs have been able to obtain more and better medical care through them than before. Dr. Erwin Liek, a leading European critic of health insurance, put it this way:

In 1904, when I was an assistant in the Danzig municipal hospital, sickness insurance had not been applied to agricultural workers. . . . What did we see in the hospital? Numerous old dislocations, badly united fractures, chronic inflammations, all of which had either not been treated at all or treated by quacks. All that was changed from the moment that the agricultural workers became compulsorily insured. . . (59).

Since the end of the Second World War there have been great extensions in health insurance coverage for rural people throughout the world. France, for example, has worked out a program to cover eventually almost the entire population with minimum services, and the voluntary mutual benefit societies supply additional benefits to those who desire and can afford

them. The same general type of extension is being made in Sweden (60). And in North America the first program of compulsory health insurance has finally been established—in the Canadian prairie province of Saskatchewan.

The CCF government was voted into power in Saskatchewan partly on the platform that it would institute a "system of socialized medical services" for the entire population. In carrying out this pledge, the government began by setting under way in January, 1947, a program of compulsory hospitalization insurance covering everyone in the province, except special dependent groups whose care was otherwise provided for. A health tax of \$5 per person is levied up to a maximum of \$30 per family. In addition, the government subsidizes the fund out of general revenues. For this money everyone is entitled to ward care and practically all services offered by the hospital, without any limitation on length of stay. The hospitals, in turn, are paid for the service by the government at a rate commensurate with the level of service rendered by the particular institution; through this plan the hospitals are stimulated continually to improve their quality of service, for in this way they get higher payments (61). The intention of the CCF government is gradually to expand services to include the care of physicians, laboratory tests, and eventually comprehensive medical care. In one "health region" of the province the comprehensive program has already been set up on an experimental basis. It is too early to draw final conclusions from this experiment on our northern border, but it is already clear that the people of this predominantly rural province are receiving through this program considerably more hospital care than ever before (62).

Finally, among foreign programs for financing medical care, must be mentioned those in which services for the general population are financed mainly out of general tax funds, rather than social insurance contributions. The most highly developed of such systems is in the Soviet Union where medical care is provided to the entire population, rural and urban, at the expense of the government. In other words, the medical care program in

that nation does not limit services to those who have established eligibility through payment of an insurance premium, because of low income, or in any other way. In the initial period the funds were raised by a system of social insurance supplemented by a direct governmental contribution, but even at that time the entire population was entitled to care. Today there are no social insurance collections as such and the entire cost is borne out of general revenues, as is done in our country in the field of public education (63).

One other nation has a method of financing medical care which makes it available to the entire population without an eligibility test, and this is New Zealand. The funds in New Zealand are raised mainly through social insurance, with supplemental contributions from the general treasury. Comprehensive services are not yet available to all and the New Zealander may be charged an extra private fee by his physician, beyond the payment made by the government for a service, but the basic structure of a system of complete public medical services has been laid (64).

While the world presents just these two examples of 100 per cent population coverage for medical care, there is an obvious trend in this direction. The extension of the French and Swedish legislation has been mentioned. The government of China has plans to finance medical care for its entire population, as soon as it can develop the financial resources, although we know that this is a good many years off. The same applies to India, if the recommendations of a special commission recently appointed to study the problem are followed. This commission recommended that the relatively small industrial population in the cities of India be provided medical care through a system of compulsory health insurance, while the great rural population should be provided services entirely at the expense of the government through general revenues (65).

Closer to our culture pattern is Great Britain. There the present government has launched a new National Health Service program to become effective in July, 1948. As in the New Zealand

and Soviet systems, all persons rural and urban will be entitled to services without an eligibility test. The scope of care will be comprehensive including not only the general practitioner's services and drugs, offered to insure workers under the original British health insurance program, but also the care of specialists, hospitalization, and auxiliary benefits. All doctors participating are expected to be on a basic salary supplemented by a capitation fee for each person choosing the particular doctor. A great network of health centers will be constructed and office space will be made available in them to private practitioners. There will be special subsidies to attract physicians to the rural areas. This program will be financed largely from the Exchequer, supplemented by a contribution from the National Insurance Fund which will also finance other social security benefits (66).

CONCLUSION

This relatively sketchy review of rural health programs in different nations hardly warrants any general conclusions that would hold true in all countries. General social and economic conditions and historical developments have been too variable in different parts of the globe to lead to any single universal approach to rural health problems everywhere. And yet it is possible to define a few principal characteristics by which efforts to tackle the rural health problem in foreign countries may be compared with those in our own.

It would seem that throughout the world a large measure of attention has been given to the problem of supplying personnel and facilities in rural areas. Over-all medical resources abroad may be poorer, but greater advantage seems to have been taken of those available. Perhaps because of greater relative rural poverty abroad or perhaps because of differences in political philosophy, foreign governments seem to have undertaken organized measures to provide care for rural people in greater degree than we have in the United States. In bringing health services to rural people, fewer distinctions have been made between the preventive realm of public health and the thera-

peutic realm of private medicine; the public health officer is called on for a great deal of medical practice and the private medical practitioner is called on for a great deal of public health work. The methods of financing medical care on a group basis have developed to a considerably higher level in many other nations than they have so far in the United States.

The central problems of rural health service in the United States probably can be described in terms of three elements: economic, ecological, and educational. The problem is economic because of the relatively low income of rural people; it is ecological because of the thin dispersion and irregular settlement of the rural population over large areas; it is educational because of lack of knowledge concerning proper hygiene among many rural people. In virtually all nations of the world these three aspects of the rural health problem are found. And no program can be successful which does not conquer the handicaps of all three. To conquer the economic handicap, various systems of financing of medical care and preventive services have been developed. To conquer the ecological handicap, there are programs for attracting personnel to outlying areas and for developing regional patterns of hospitals and health centers. To conquer the educational handicap, programs of public health have been extended.

It is obvious that we have a great deal to learn from the numerous rural health measures undertaken in other nations. This paper has not attempted to review the special steps taken in the United States to improve rural health, but it is equally certain that other nations have much to learn from us.

Although we have considered health programs around the world from the special point of view of rural areas, it should be clear that the rural health problem can never be solved in a vacuum independent from the health problems of any nation as a whole. Most of the large-scale efforts to improve rural health and medical care abroad have been launched as an aspect of a general health program for the entire nation. If rural people are to enjoy all the benefits of modern medical science,

the closest possible tie-up with urban medicine is obviously essential, since the centers of medical research and education will naturally be in the cities. The financial support for rural health services must likewise come in large measure from urban wealth, through public taxation, if compensations are to be made for the economic disadvantages of agriculture in this industrial civilization.

Whatever may be the differences among nations in political and economic matters, it would seem that in the realm of public health and medical science a truly international spirit can be observed. If we will take full advantage of the lessons of the entire world, we may be confident that the objective of the World Health Organization to assure "the attainment by all peoples of the highest possible level of health" will some day be realized.

ACKNOWLEDGEMENT: For technical assistance in the preparation of this paper, acknowledgement is gratefully made to George St. J. Perrott, Miss Martha D. Ring, Arthur Weissman, and E. B. Kovar.

REFERENCES

1. Hall, W. W.: Health of Farmers' Families. *Report of the Commissioner of Agriculture for the Year 1862*, Washington, pp. 453-470.
2. Moore, Harry H.: AMERICAN MEDICINE AND THE PEOPLE'S HEALTH. New York, D. Appleton and Company, 1927, pp. 194-195.
3. Hoge, Vane M.: The Hospital Survey and Construction Act. *Public Health Reports*, January 10, 1947, 62, pp. 49-54.
4. Sand, René: HEALTH AND HUMAN PROGRESS. New York, The Macmillan Company, 1936.
5. Barkhuus, Arne: The Health of Nations. *Ciba Symposia*, October, 1943, 5, No. V.
6. Stampar, Andrija: Observations of a Rural Health Worker. *New England Journal of Medicine*, June 16, 1938, 128, pp. 991-997.
7. Winslow, C.-E. A.: THE CONQUEST OF EPIDEMIC DISEASE. Princeton, New Jersey, Princeton University Press, 1944.
8. Evang, Karl: MEDICAL SERVICE IN NORWAY. Processed, London, 1944, p. 11.
9. The Royal Social Board: SOCIAL WORK AND LEGISLATION IN SWEDEN. Stockholm, Tryckeriskiebolaget Tiden, 1938.

10. Cassidy, Harry M.: PUBLIC HEALTH AND WELFARE REORGANIZATION—THE POSTWAR PROBLEM IN THE CANADIAN PROVINCES. Toronto, The Ryerson Press, 1945.
11. Reports of the Health Division of the United Nations Relief and Rehabilitation Administration (UNRRA), Rome, 1945.
12. Notes and forthcoming reports by George St. J. Perrott and Dr. Joseph W. Mountin, United States Public Health Service, following observations on health programs in Western Europe during July–August, 1946.
13. Sigerist, Henry E.: Socialized Medicine Abroad. *Journal of the Association of Medical Students*, April, 1939.
14. League of Nations Health Organization: EUROPEAN CONFERENCE OF RURAL HYGIENE: MINUTES. Geneva, 1931.
15. United States Public Health Service: Progress toward a World Health Organization. *Public Health Reports*, February 14, 1947, 62, pp. 225–248.
16. Wallgren, Arvid: Some Aspects of the Medical Profession in Sweden. *Canadian Medical Association Journal*, December, 1946, 55, pp. 605–610.
17. Swedish Traffic Association: SWEDEN—ANCIENT AND MODERN. Stockholm, 1939. Also information furnished by George St. J. Perrott, United States Public Health Service.
18. Personal communication from Dr. Sze, Chinese representative in Health Division of UNRRA, 1945.
19. SUMMARY REPORT BY THE DEPARTMENT OF HEALTH FOR SCOTLAND FOR THE YEAR ENDED 30TH JUNE, 1945. Edinburgh, 1945.
20. Department of Health for Scotland: COMMITTEE ON SCOTTISH HEALTH SERVICES REPORT. Edinburgh, His Majesty's Stationery Office, 1936, pp. 221–233.
21. Rorem, C. Rufus: THE "MUNICIPAL DOCTOR" SYSTEM IN RURAL SASKATCHEWAN. Chicago, University of Chicago Press, 1931.
22. Information furnished by Dr. F. D. Mott, Chairman of the Saskatchewan Health Services Planning Commission, 1946.
23. Moll, A. A.: AESCULAPIUS IN LATIN AMERICA. 1944.
24. Sigerist, Henry E.: Rural Health Services in the Soviet Union. *American Review of Soviet Medicine*, February, 1944, 1, pp. 270–280.
25. Westphal, Edward A.: Medical Pioneers in the Peruvian Amazon. *Medical Record*, March, 1945, pp. 134, 138, and 142.
26. Chesterman, Clement C.: TROPICAL DISPENSARY HANDBOOK. (An aid to the Training and Practice of Native Medical Assistants and for the Guidance of All Engaged in Medical Practice in Rural Dispensaries in the Tropics). London, United Society for Christian Literature, 1946.
27. Cohen, Wilbur J.: Social Security in Chile. *Social Security Bulletin*, May, 1947, 10, No. 5, pp. 10–19.
28. Same as reference 24.
29. Information furnished by Dr. J. L. Sanders, Chief Dental Officer of New Zealand Ministry of Health, July, 1947.
30. Sigerist, Henry E.: Yugoslavia and the XIth International Congress of the History of Medicine. *Bulletin of the History of Medicine*, January, 1939, 7, pp. 99–147.

31. Same as reference 12.
32. SOCIAL DENMARK: A SURVEY OF THE DANISH SOCIAL LEGISLATION. Copenhagen, Socialt Tidsskrift, 1945.
33. Martensen-Larsen, Florian: Den Amerikanske Sygehuslov af 1946. *Socialt Tidsskrift*, February, 1947, 23, pp. 67-76.
34. O'Leary, Shirley B. and Moll, A. A.: HEALTH AND LIVING CONDITIONS IN LATIN AMERICA. Washington, Pan-American Sanitary Bureau, July, 1941, Pub. No. 166.
35. Mountin, Joseph W. and Hoenack, August: The Health Center: Adaptation of Physical Plants to Service Concepts. *Public Health Reports*, September 20, 1946, 61, pp. 1369-1379.
36. Same as reference 4.
37. Same as reference 30.
38. Same as reference 27.
39. Medical and Health Aspects of Social Security in Latin America. *Bulletin of the Pan-American Union*, January, 1939.
40. Same as reference 24.
41. Sigerist, Henry E.: A Physician's Impression of South Africa. *Bulletin of the History of Medicine*, January, 1940, 8, pp. 22-27.
42. Grant, John B., in an address at the Institute of Social Medicine, New York Academy of Medicine, New York, March 20, 1947.
43. Mott, F. D. and Roemer, M. I.: A Federal Program of Public Health and Medical Services for Migratory Farm Workers. *Public Health Reports*, March 2, 1945, 60, pp. 229-249.
44. Turkish Republic, Ministry of Health and Social Welfare: FIRST TEN YEAR HEALTH PLAN. Ankara, 1947, p. 82.
45. Sigerist, Henry E.: MAN AND MEDICINE. New York, Norton and Company, 1932.
46. Larsen, Nils P.: Analysis of Health on our Plantations. *Plantation Medicine*, (Hawaii), January, 1944, 8, pp. 4-20.
47. Same as reference 30.
48. Sigerist, Henry E.: From Bismark to Beveridge: Developments and Trends in Social Security Legislation: I. The Period of Bismarck. *Bulletin of the History of Medicine*, April, 1943, 13, pp. 365-388.
49. Newsholme, Sir Arthur: MEDICINE AND THE STATE. London, Allen and Unwin, 1932.
50. Perrott, George St. J. and Mountin, Joseph W.: Voluntary Health Insurance in Western Europe: Its Origins and Place in National Programs. *Public Health Reports*, May 23, 1947, 62, pp. 733-767.
51. Cohen, Wilbur J.: Foreign Experience in Social Insurance Contributions for Agricultural and Domestic Workers. *Social Security Bulletin*, February, 1945, 8, No. 2, pp. 5-10.
52. Armstrong, Barbara N.: THE HEALTH INSURANCE DOCTOR. Princeton, Princeton University Press, 1939.
53. Same as reference 12.

54. Same as reference 52.

55. The Scottish Rural Workers Approved Society: TWENTY-SIXTH ANNUAL REPORT BY THE BOARD OF MANAGEMENT, 1938-39. Edinburgh, Registered Office.

56. Memorandum of Evidence by the National Federation of Rural Approved Societies. SOCIAL INSURANCE AND ALLIED SERVICES (Memorandum from Organizations, Appendix G to Report by Sir William Beveridge). London, 1942.

57. War Department Technical Bulletin: MEDICAL AND SANITARY DATA ON JAPAN. May, 1945, TB Med. 160.

58. Mountin, Joseph W. and Perrott, George St. J.: Health Insurance Programs and Plans in Western Europe: A Summary of Observations. *Public Health Reports*, March 14, 1947, 62, pp. 369-399.

59. Quoted in: Falk, I. S.: SECURITY AGAINST SICKNESS. New York, Doubleday, Doran, and Company, 1936, pp. 288-289.

60. Same as reference 50.

61. Province of Saskatchewan: THE HOSPITAL SERVICES PLAN AND ITS PLACE IN SASKATCHEWAN'S PUBLIC HEALTH PROGRAM. Regina, Processed, 1946.

62. Mott, Frederick D.: The Saskatchewan Hospital Services Plan. *Physicians Forum Bulletin*, January-February, 1947, pp. 20-25.

63. Sigerist, Henry E.: SOCIALIZED MEDICINE IN THE SOVIET UNION. New York, Norton and Company, 1937.

64. Robb, Douglas: HEALTH REFORM IN NEW ZEALAND. London, Whitcombe and Tombs Ltd., 1947.

65. Personal communication from Dr. Henry E. Sigerist, 1946.

66. Ministry of Health of Great Britain: NATIONAL HEALTH SERVICE BILL—SUMMARY OF THE PROPOSED NEW SERVICE. London, March, 1946.

A STATISTICAL STUDY OF CANCER AMONG DIABETICS

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FROM a review of the literature there are indications of a positive association between cancer and diabetes mellitus (1-7), though the evidence is open to statistical objection. It is hoped that this paper will throw some additional light on the subject, since from the statistical data presented herein cancer appears to be associated with diabetes.

CLINICAL DATA

In recent years two rather comprehensive reports based on clinical data have been published in this country. A 1934 report by Marble (3) considered the problem primarily from the point of view of diabetes while a 1944 report by Ellinger and Landsman (5) emphasized the oncological aspect. The two reports are in agreement on the fact, as stated by Marble, that "one would seem to be dealing in general with a group of diabetic patients who later developed cancer rather than with a group of patients with malignant disease who developed diabetes." In view of the relative durations of the two conditions, it is reasonable to accept this opinion. The problem, therefore, is

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The work on this study was started while the author was Statistician, New York City Department of Health and Senior Assistant Sanitarian (R) USPHS, detailed to the Medical Examination Program, War Shipping Administration.

Acknowledgments are made to Mr. Louis Weiner, Chief Statistician and Mrs. Katherine Arth, New York City Department of Health for assistance in tabulating the special mortality data for New York City.

The statistics from the National Health Survey were tabulated and analyzed with the assistance and cooperation of Dr. Selwyn D. Collins, Head Statistician, Division of Public Health Methods during a temporary assignment, for which the author is indebted to Asst. Surgeon General Justin K. Fuller. Acknowledgments are also made to Miss Daisy Segal, Ralph A. Davin, and Miss Helen Aldrich for assistance in collating and tabulating these data.

The author is also grateful for helpful suggestions and criticism to Dr. Collins, to Dr. Louis I. Dublin, Second Vice-President and Statistician and Herbert H. Marks, Manager, Insurance Medical Statistics, both of the Metropolitan Life Insurance Company, to Dr. Friedrich P. Ellinger, Research Associate Director, Department of Radiology, Long Island College of Medicine, to Dr. Morton L. Levin, Director of Cancer Control, New York State Department of Health, and to Dr. Alexander Marble, Boston, Massachusetts.

basically one of ascertaining whether cancer occurs more frequently than expected among diabetics.

In the series of diabetics reported on by Ellinger and Landsman, 3.04 per cent were found to have cancer. This is not greatly different from the findings (2.56 per cent) for the group of cases reported on by Marble. On the basis of fewer cases, other authors have reported cancer to be associated with one to nine per cent of the diabetics covered in their series. In the absence of adequate data in these reports, especially of age and of period of observation, it is not possible to ascertain from them the relative frequency of cancer among these different series of diabetics. Furthermore, assuming that the clinician has satisfactorily established the incidence or prevalence of cancer among a group of diabetics, he is confronted with the problem of selecting a control group by means of which the biological significance of his findings can be evaluated. Marble, recognizing the serious objections to the procedure used for appraising his data, correctly concluded that "while certain evidence would seem to indicate that cancer is more common among diabetics, such a conclusion is open to serious criticism."

Ellinger and Landsman, on the other hand, evaluated the data for their diabetic population which had been under observation for more than one year on the basis of the 1941 cancer incidence (cases first reported in that year) in the general population of New York State (exclusive of New York City). From this comparison they concluded that "the diabetic seems to be more liable to develop cancer." Obviously, this conclusion is not tenable because of the nature of the comparison made.

A serious objection to the use of clinical data may arise from the fact that patients who attend hospital clinics may not comprise a representative sample of all diabetics in the population (8). Primarily, this may be due to two factors: (a) these diabetics may be different from others who are not under care by the very fact that they are under care and (b) some of the diabetics found to have cancer may have sought care because the coexistence of the latter condition aggravated the diabetic

symptoms. The possible bias introduced by the selection of a special population, *e.g.*, hospital patients, may be minimized or eliminated by means of a longitudinal study of the original sample. In other words, it is possible to select a sample of patients who received their first examination in a specified period of time and then to ascertain their mortality experience in subsequent years, since the effects of any bias introduced by the original selection will be reduced and eventually eliminated among those who survive.

From detailed mortality data made available by the Metropolitan Life Insurance Company, it is possible to remove most of the statistical objections to the data as previously published for the experience of the George F. Baker Clinic in Boston (3, 4, 9). These data are based on the mortality experience for the ten-year period from 1929 to 1938 among a 25 per cent sample of all diabetics examined from 1897 to 1938 and exclude diabetics who were moribund or whose death occurred within one week of first observation or hospital discharge. Unfortunately, it is not possible to determine the chronological trend of cancer mortality for these diabetics from the data as presently tabulated. However, in view of the fact that a large proportion of these diabetics were first observed from 1897 to 1928, years before the period of this mortality experience (1929-1938), and that moribunds have been excluded, it is probable that any original bias in the representativeness of the sample has been minimized. Moreover, since the data are tabulated by sex and years of life exposed to death according to attained age, the effects of variations in age, sex, and years of exposure can be eliminated from the analysis.

During the ten-year period, 1929 to 1938, 83 deaths were attributed to cancer among this sample of diabetics—or a rate at all ages combined of 5.3 cancer deaths per 1,000 years of life exposed. How does this experience compare with the cancer mortality experience of the general population? This question can best be answered by comparing the diabetic's experience with the number of cancer deaths which would have been ex-

pected among them if their cancer mortality experience had been similar to that of the general population. A number of facts must be considered, however, when selecting a suitable criterion for determining their expected cancer mortality experience. First, it should be noted that most of the diabetics in this experience were originally drawn from and eventually died in Massachusetts or other areas in the Northeastern part of the United States. Second, few nonwhites are included in this experience. Third, it is generally recognized that a major factor in the upward trend of standardized cancer mortality rates in past years was the increasing recognition and diagnosis of cancer as a cause of death. Finally, since diabetics are more likely than the general population to be under medical care, it is possible that their reported cancer mortality experience more closely approximates the true frequency of cancer as a cause of death. In view of the above, the 1940 age-sex specific cancer mortality rates for the white population in Massachusetts (10) have been used to determine the expected number of cancer

Table 1. Expected cancer mortality experience from 1929 to 1938 among a 25 per cent sample of diabetics examined at the George F. Baker Clinic in Boston from 1897 to 1938.

ATTAINED AGE GROUP	MALES			FEMALES			TOTAL EX- PECTED CANCER DEATHS
	Years of Life Ex- posed	Ex- pected Cancer Death Rate ¹	Ex- pected Cancer Deaths	Years of Life Ex- posed	Ex- pected Cancer Death Rate ¹	Ex- pected Cancer Deaths	
0-4	16.42	7.8	.0013	18.33	3.6	.0007	.0020
5-14	367.41	3.3	.0121	372.79	4.1	.0153	.0274
15-24	656.67	7.9	.0519	585.90	4.2	.0246	.0765
25-34	658.24	13.8	.0908	539.85	21.0	.1134	.2042
35-44	934.39	39.8	.3719	816.59	86.6	.7072	1.0791
45-54	1218.80	154.0	1.8770	1585.58	221.2	3.5073	5.3843
55-64	1652.96	415.3	6.8647	2571.99	475.8	12.2375	19.1022
65-74	1106.43	953.8	10.5531	1875.67	811.4	15.2192	25.7723
75-84	283.70	1544.1	4.3806	407.02	1334.6	5.4321	9.8127
85-89	9.26	1627.3	.1507	3.25	1407.9	.0458	.1965
ALL AGES	6904.28	—	24.3541	8776.97	—	37.3031	61.6572

¹ 1940 Massachusetts cancer death rates per 100,000 white population; rates for age groups 0-4 and 85-89 are those for ages 1-4 and 85 and over respectively.

deaths among these diabetics. As may be seen from Table 1, judged by this criterion 62 deaths from cancer should have occurred. Thus it is apparent that the diabetics in this sample were reported to have at least one-third more cancer deaths than expected during the period from 1929 to 1938. The evidence, therefore, appears to confirm the hypothesis that there is a positive association between diabetes and cancer.

MORTALITY DATA

Some reports in the literature are based on data from official death records. The 1932 study by Wilson and Maher of associated causes of death as recorded on death certificates in Massachusetts revealed a positive association for cancer and diabetes (2). Do other available mortality data confirm this statistical relationship?

Mortality data are relatively easy to obtain for analysis and since they are frequently misused or misinterpreted, it is desirable to devote extensive consideration to their significance. Mortality ratios may be based on the universe of the dead (*e.g.*, 11.17 per cent of all deaths which occurred in the United States in 1940 were attributed to cancer) or on the universe of the living (*e.g.*, cancer was reported to have caused the death of 0.12 per cent of the United States population in 1940). Since the population from which deaths arise is not always known, *e.g.*, among an autopsied population, mortality ratios based on the universe of the dead have sometimes been used to ascertain the relationship between two conditions or diseases. What is disclosed by an analysis of the association of cancer and diabetes mellitus among dead persons?

UNIVERSE OF DEAD PERSONS

DATA FOR THE UNITED STATES

From a special tabulation of associated causes of death as recorded on death certificates in the United States in 1940, it is possible to determine the frequency with which cancer and other diseases are reported together with diabetes (11). As

may be seen from Table 2, which was constructed from those data, among the dead, cancer is reported for 11.6 per cent of the nondiabetics but for only 4.0 per cent of the diabetics. Even cancer of the digestive organs and peritoneum, which includes the pancreas, is reported twice as frequently for nondiabetics. As will be shown subsequently, however, these facts do not indicate that cancer and diabetes are dissociated.

THE INFLUENCE OF INCOMPLETE REPORTING OF CAUSES
ON DEATH CERTIFICATES

Sole reliance on associated conditions recorded on death cer-

Table 2. Frequency of cancer and other selected diseases among diabetics and among nondiabetics at the time of death, United States, 1940.

DISEASE AND INTERNATIONAL LIST NUMBER	DIABETICS		NONDIABETICS	
	Number	Per Cent	Number	Per Cent
Total, Known and Defined	33,653	100.0	1,357,456	100.0
Cancer, All Sites, All Forms (45-55)	1,348	4.0	157,015	11.6
Cancer of Digestive Organs and Peritoneum (46)	753	2.2	72,002	5.3
Tumors, Non-malignant and Unspecified (56, 57)	115	0.3	6,542	0.5
Tuberculosis (13-22)	804	2.4	59,642	4.4
Pneumonia and Influenza (33, 107-109)	2,152	6.4	92,546	6.8
Ulcer of Stomach or Duodenum, Ap- pendicitis, Hernia, Cirrhosis of Liver, etc. (117, 121, 122, 124)	892	2.6	44,681	3.3
Intracranial Lesions of Vascular Origin (83)	3,474	10.3	119,776	8.8
Diseases of the Heart (90-95)	12,339	36.7	385,273	28.4
Other Diseases of the Circulatory System (96-103)	3,353	10.0	28,763	2.1
Biliary Calculi, etc. (126, 127)	261	0.8	7,773	0.6
Diseases of the Pancreas (128)	101	0.3	842	0.1
Nephritis (130-132)	4,267	12.7	107,355	7.9
All Others	4,547	13.5	347,248	25.5
Ill Defined and Unknown (199, 200)	5,353	—	20,807	—
GRAND TOTAL	39,006	—	1,378,263	—

SOURCE: Primary and secondary causes of death as reported in "Vital Statistics of the United States, 1940, Part I," Bureau of the Census, U. S. Department of Commerce, Washington, Government Printing Office, 1943, pages 570-623. Deaths attributed to ill-defined and unknown causes are here assigned to their associated cause.

tificates is usually a risky matter. Less than thirty years ago, only one-third of all certificates filed in the United States Death Registration Area reported more than one morbid condition (related and overlapping conditions and diseases included). While great improvement has been made in the completeness of reporting contributory and associated causes, it is worth noting that as recently as 1940 only a little more than one-half (55.4 per cent) of the death certificates filed in the United States reported more than one cause (12).

If this is true for deaths from all causes, may we expect a smaller proportion of secondary causes reported on death certificates for which the deceased were known to have a cancer or diabetes mellitus? Are certifying physicians less likely to report a contributory or an associated cause for deaths for which the primary cause is known to be an acceptable "killer"—a major disease or condition?

The importance of the above cannot be overstressed. For example, if some of the cancer deaths tabulated for nondiabetics were due to failure of physicians to report diabetes mellitus as a contributory or an associated condition when it actually existed, then the reported frequency of cancer was decreased among diabetics.

What effect, if any, incomplete reporting may have had on the data presented in Table 2 cannot be determined. That not all diseases and conditions known to have existed prior to death are reported on death certificates may be seen from analysis of unpublished data for a selected sample of 6,938 white deaths reported in New York City proprietary and municipal hospitals in 1937-1939 and 1941 (13).

Among the 6,938 deceased persons there were 1,280 diagnosed as having cancer, but only 1,216, or 95.0 per cent, were so reported on their death certificates. Also, there were 533 deceased persons who had been diabetic, but only 407, or 76.4 per cent, of the death certificates reported diabetes mellitus. Omissions in varying proportions are also evident for other conditions and diseases.

Equally pertinent is the fact that significantly fewer diabetics are reported on death certificates among persons for whom cancer is reported. Among these persons (1,216 for whom cancer was recorded on their death certificate), there were 57 who had been diabetic but on only 35, or 61.4 per cent, of the certificates was diabetes mellitus recorded as a contributory or an associated condition.

If we may assume (though without any justification) that these figures approximate the extent of under-reporting of diabetes on death certificates from all sources in the United States (including voluntary hospitals, private physicians attending persons who die at home, *etc.*), we can correct the cancer frequencies presented in Table 2 to allow for the effects of incomplete reporting. Adjusted on this basis, cancer is found to be associated with 5.0 per cent of the diabetics (instead of 4.0 per cent) and with 11.6 per cent of the nondiabetics (not affected by correction).

No doubt there are many reasons why all diseases and conditions are not reported on death certificates, including the fact that the condition may not have contributed to death. And it is probable that physicians are less likely to report contributory and associated causes when a major disease or condition is the primary cause of death. Regardless of the reasons for these omissions, however, contributory and associated causes reported on death certificates are probably not yet sufficiently complete to warrant critical studies of associated causes of death solely on the basis of data from death certificates.

NEW YORK CITY SPECIAL MORTALITY DATA

The New York City special mortality data (13) provide an efficient means of determining the relative association of cancer and diabetes at the time of death. These data, for white persons only, classified according to sex, by selected age groups, are presented in Table 3.

It is interesting to observe from this table that at the time of death cancer is less frequently reported among diabetics than

among nondiabetics; the rate per one hundred for all ages combined among males is 12.3 for diabetics and 18.4 for nondiabetics, and among females it is 10.3 and 19.8 respectively.

Granted that cancer is less frequently found among diabetics than among all other persons at the time of death, does this

Table 3. Cancer among diabetics and among nondiabetics at the time of death, white population, deaths reported in proprietary and municipal hospitals, City of New York, 1937-1939 and 1941.¹

AGE IN YEARS	MALES		FEMALES	
	Diabetics	Nondiabetics	Diabetics	Nondiabetics
TOTAL DEATHS				
0-4	0	636	0	446
5-14	1	34	1	45
15-24	1	69	0	83
25-34	7	138	6	196
35-44	3	273	16	331
45-54	23	523	50	441
55-64	73	756	123	618
65-74	71	644	102	553
75 and Over	24	332	32	287
All Ages	203	3,405	330	3,000
NUMBER OF DEATHS WITH CANCER				
0-4	—	5	—	0
5-14	0	2	0	0
15-24	0	6	—	1
25-34	0	11	0	13
35-44	1	32	2	68
45-54	2	118	8	123
55-64	11	210	12	200
65-74	9	175	12	137
75 and Over	2	67	0	53
All Ages	25	626	34	595
PER CENT OF DEATHS WITH CANCER				
45-54	8.7	22.6	16.0	27.9
55-64	15.1	27.8	9.8	32.4
65-74	12.7	27.2	11.8	24.8
75 and Over	8.3	20.2	0	18.5
All Ages	12.3	18.4	10.3	19.8

¹ Excludes deaths due to accidental causes and others certified by the medical examiner's office.

fact indicate that diabetes is dissociated from cancer? Some persons have erroneously reached this type of conclusion on the basis of associated conditions among the dead. The classical example found in the literature involves the association of cancer and tuberculosis (14). By means of autopsy data, the frequency of active tuberculosis in persons dead of cancer and those dead of other causes including tuberculosis was compared. On the basis of a negative relationship between cancer and tuberculosis, it was concluded that tuberculosis was antagonistic to the development of cancer. That the noncancerous group did not constitute a valid control group was shown in a subsequent study, wherein it was revealed that the frequency of active tuberculosis in persons dead of heart disease was as low as in the cancer death group (15). In other words, it is not sufficient to show that a condition is less frequently associated with another at the time of death, but rather that it is less frequently associated with it than it is with other diseases and conditions.

In order to apply this principle to the relationship between cancer and diabetes, the New York City special mortality data

Table 4. Cancer associated with selected conditions at the time of death, white population, 25 or more years of age, deaths reported in proprietary and municipal hospitals, City of New York, 1937-1939 and 1941.¹

CONDITION	NUMBER WITH CONDITION		NUMBER WITH CANCER					
			Observed		Expected ²		Ratio ³	
	Males	Fe- males	Males	Fe- males	Males	Fe- males	Males	Fe- males
Diabetes Mellitus	201	329	25	34	48.3	80.7	.52	.42
Tuberculosis (All forms)	136	65	13	8	27.4	12.6	.47	.63
Syphilis	88	29	13	3	20.2	6.9	.64	.43
Cardiovascular- Renal Disease	925	905	28	20	210.2	206.4	.13	.10

¹ Excludes deaths due to accidental causes and others certified by the medical examiner's office.

² Based on the age-sex specific proportionate frequency of cancer as a cause of death among all deaths in the sample applied to the age distribution of deaths in each diagnostic-sex group.

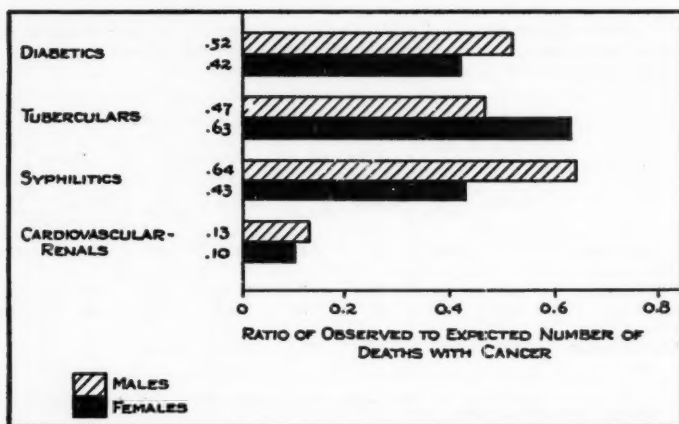
³ Ratio of observed to expected number of deaths with cancer.

have been used to set up four diagnostic groups: (a) diabetes mellitus, (b) tuberculosis (all forms), (c) syphilis, and (d) cardiovascular-renal diseases. Tuberculosis (2) and syphilis (16) were set up since cancer is generally recognized to be associated with these conditions. The relationships between these conditions and the control group, the cardiovascular-renal diseases, will, therefore, serve as a check on the findings for cancer and diabetes.

A comparison of the expected and observed frequency of cancer among males and females for these groups is given in Table 4. Since the "expected number" was derived from the age-sex specific proportionate frequency of cancer as a cause of death among all deaths² in the sample applied to the age distribution of deaths in each diagnostic-sex group, the influence of age differences has been eliminated from the data.

As may be seen from these data, cancer is associated with diabetes mellitus among the dead to relatively the same extent as it is with syphilis and with tuberculosis. Cancer is, however,

Fig. 1. Cancer associated with selected conditions at the time of death, white population, 25 or more years of age, deaths reported in proprietary and municipal hospitals, City of New York, 1937-1939 and 1941.



² Excludes deaths due to accidental causes and others certified by the medical examiner's office.

associated with the cardiovascular-renal diseases to a significantly lesser extent than it is with diabetes. These relationships are readily seen in Figure 1, which presents the ratios of observed to expected number of deaths with cancer for these four groups.

Since cardiovascular-renal diseases are not thought to be correlated with cancer, the frequency of cancer among persons dead of these diseases does constitute a valid means for evaluating the association of cancer with diabetes. Judged by this criterion, the data appear to indicate that cancer is positively associated with diabetes.

UNIVERSE OF LIVING PERSONS
DATA FOR THE UNITED STATES

Wilson (17) takes a different approach to this problem but with comparable results. If we are interested in ascertaining the relative frequency with which conditions occur in pairs at the time of death, then a universe of dead persons is a proper one to use. If, on the other hand, we wish to reason in regard to the functioning state of an individual, we must study a population of living persons. Since we intend to determine relationships in order to ascertain whether one condition is predisposing or antagonistic to another, we should use a universe of living persons.³

Wilson found for mortality from cancer and diabetes dissociation in the universe of the dead (17) and association in the total population (2). It is not possible to relate the New York City special mortality data to a living population, for reasons similar to those which occur in regard to an autopsied population. The 1940 mortality data for the United States and 1930 data for New York City, therefore, will be used to investigate the latter finding.

The 1940 population of the United States was 131,669,275 and, from Table 2, deaths were as follows: cancer—158,363;

³ Wilson has termed the use of a universe of dead persons for this purpose the statistical fallacy of "observational selection."

diabetes mellitus—39,006; and with both causes—1,348. If we assume that the two causes of death fell independently upon the total population, the expected number of deaths from both cancer and diabetes is $46.9 - (158,363) \times (39,006) \div 131,669, - 275$. Thus, the reported number of deaths with both conditions was 29 times more frequent than expected.

An even greater ratio is derived from 1930 data for New York City (18). Among an estimated population of 6,954,700 persons, deaths were reported as follows: cancer—8,125; diabetes—1,784; and with both causes—74, or 35 times the expected number (2.1).

Would association be disclosed if the expected number of deaths was calculated specific for age, sex, and color? This may be done for the United States by applying the 1940 age-sex-color specific cancer death rates for the United States (10) to the comparable distribution of deaths charged to diabetes (19). From these computations, the expected number of deaths with both diabetes and cancer is found to be 210. Since 1,348 deaths were reported with both conditions, cancer and diabetes were reported jointly 6.4 times more frequently than might be expected on the assumption that the two conditions caused death independently. Similarly, the 1930 data for New York City give a ratio of 6.4 (11.53 deaths expected in contrast to 74 reported).⁴

Thus it is evident that available mortality data indicate that cancer and diabetes mellitus are positively associated as causes of death.

MORBIDITY DATA

Would comparable results be obtained if as is more logical morbidity rates were used, rather than mortality rates, to evaluate the relationship of the two conditions?

⁴ From Massachusetts data for a ten-year period (1902, 1912, and 1920-1927), classified by age and sex, Wilson (2) reported a ratio of 64, which is ten times greater than the ratios found for the United States and for New York City. Analysis of the Massachusetts data appears to indicate that the reported frequency of deaths from both cancer and diabetes was extremely high; cancer was reported for 34 per cent of the diabetics in contrast to 3.5 per cent and to 4.1 per cent for the United States and for New York City respectively, and to 10 to 12 per cent for all known diabetics at the time of death (Table 3).

There is no report of morbidity data in regard to cancer among diabetics available in the literature. Collection of such data involves costly, time-consuming efforts of a large organization regardless of whether the data be amassed by means of a continuous reporting system, a canvass or an intensive diagnostic investigation of a representative group of the population. The author was thus fortunate in obtaining access to unpublished prevalence data on diabetes mellitus, cancer,⁵ and other conditions, which were made available by the National Health Survey (20, 21).

DESCRIPTION OF DATA

The survey data are based on schedules taken in 83 cities for 703,092 households, comprising 2,502,391 individuals, distributed so as to give a fairly representative sample of the urban population in the United States during the winter of 1935-1936. In addition to other related social and economic information obtained by interview with the housewife or other responsible member of each household, morbidity data were requested concerning: (a) illness keeping a person from work, school, or other usual activity on the day of the canvass; (b) illness which had disabled a person in the above sense continuously for seven days or more during the twelve months preceding the date of the canvass, including all hospitalized cases and all confinements; (c) all fatal cases during the past twelve months regardless of the duration of disability, and (d) all other handicapping diseases and conditions of a chronic nature.

The prevalence data used herein have been limited to the white population (includes a small percentage with color unknown but excludes Mexicans residing in California and Texas), 25 or more years of age, canvassed in the National Health Survey—a total of 1,310,051 individuals.

CANCER AMONG DIBETICS

There were 2,912 males and 5,278 females reported as di-

⁵ Cancer was defined in the National Health Survey according to its definition in the 1938 revision of the International List of Causes of Death.

Table 5. Cancer prevalence among all persons and among diabetics, classified by age and sex, white persons,¹ 25 or more years of age. The National Health Survey, 1935-1936.

AGE (YEARS)	MALES						FEMALES					
	Total			Diabetics			Total			Diabetics		
	Number in Survey	With Cancer		Number in Survey	With Cancer		Number in Survey	With Cancer		Number in Survey	With Cancer	
		Num- ber	Pro- portion		Ob- served	Ex- pected (4)×(5)		Number	Pro- portion		Ob- served	Ex- pected (10)×(11)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
25-34	170,610	27	.000153	167	0	.03	200,845	68	.000339	215	0	.07
35-44	170,610	95	.000557	352	2	.20	180,911	283	.001288	555	2	.71
45-54	138,194	283	.001086	651	4	1.10	138,119	391	.002831	1,215	8	3.44
55-64	81,843	372	.004545	848	7	3.85	89,064	449	.005041	1,649	12	8.31
65-74	43,466	399	.009180	675	4	6.20	52,309	371	.007092	1,289	14	9.14
75-84	14,885	191	.013278	206	1	2.74	18,794	219	.011690	335	1	3.62
85-99	2,036	21	.010314	13	0	.13	2,925	37	.012650	20	0	.25
TOTAL—	627,144	1,338	—	2,912	18	14.25	682,907	1,768	—	5,278	37	25.84

¹ Includes a small percentage with color unknown but excludes Mexicans residing in California and Texas.

abetic among urban white adults, 25 or more years of age, included in the National Health Survey. Cancer was recorded for 18, or 0.6 per cent, of these diabetic males and for 37, or 0.7 per cent, of these females. These data by age according to sex are shown in Table 5.

Inspection of the data in the separate age groups reveals that the diabetic individuals were reported to have more cancer than the general population included in the survey up to age 65 among men and up to age 75 among women, but less at the older ages.⁶ This relationship can be readily observed from Figure 2, which presents the reported cancer prevalence rates by sex and age groups from 35 to 84 years of age.

It may also be seen from Table 5 that for all ages combined the observed number of individuals with cancer exceeds the expected among both male and female diabetics; the ratio of observed to expected number of cases with cancer is 1.26 among males and 1.43 among females. However, the findings for males may be due to chance sampling, but those for females and for both sexes combined are statistically significant.⁷

There is evidence from the data, therefore, that cancer was reported more frequently than expected among diabetics. May we conclude that cancer is associated with diabetes or can this finding have resulted from some bias in the data?

For example, it is possible that respondents who are sufficiently cooperative to report one illness (condition or disease)

⁶ This observation raises a question concerning the meaning of the heterogeneity in the data by age. The possibility that there is a relationship with age in the association between cancer and diabetes as well as between cancer and other conditions may be noted from other data (2). It would be difficult, however, to draw such a conclusion from the National Health Survey data since it is very unlikely that they are sufficiently accurate or representative for older persons. Primarily this results from the fact that persons absent from their household for one month or longer who were in homes for the aged or the incurable were excluded from the survey. Also, persons who had gone from their household to an institution for the care of disease anytime previously (and were still there) were included in the survey if reported by the family respondent, but obviously the record obtained was incomplete. These facts would appear to be especially important in the case of older persons with diabetes and/or cancer. Finally it is unlikely that respondents passed 70 years of age supplied accurate and complete information.

⁷ The respective probabilities of obtaining deviations from the expected number as great or greater than those observed due to chance are .19 for males, .02 for females, and .01 for both sexes combined.

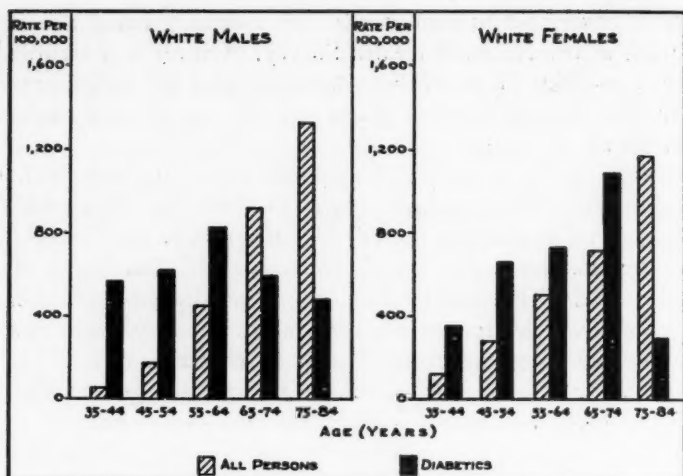


Fig. 2. Cancer prevalence rates among white diabetics and among all white persons, 35 to 84 years of age, included in the National Health Survey, 1935-1936.

are more likely to report all known associated or contributory conditions. If this were actually true, the data would reveal a greater association than really existed for any pair of conditions.

Another bias which may exist could result from the fact that diabetics are more likely to be under medical care than other persons in the population.⁸ As such, therefore, the known prevalence of cancer among diabetics could more closely approximate the true prevalence. In other words, if a cancer develops, it is more likely to be diagnosed since the diabetic is more frequently and more thoroughly examined.

In order to give due consideration to the possible effects of these two biases, it is necessary to ascertain the prevalence of cancer among a control group of nondiabetics who also might be more likely to be under medical care than the general popu-

⁸ This bias could be kept to a minimum but not necessarily eliminated even in an intensive diagnostic survey since the diabetic could supply a more complete history of existing conditions and he would thus reduce the chances of an existing cancer being overlooked.

lation. The condition selected for this purpose could not be related to or associated with diabetes mellitus nor with cancer, and a relatively large number of cases had to be available for study. Nondiabetics with sinusitis was the control group selected since it most closely approximated these requirements.

CANCER AMONG NONDIABETICS WITH SINUSITIS

A total of 12,622 white adults, 25 or more years of age, was reported in the survey as having sinusitis but not diabetes mellitus. Among these persons, 11, or 0.2 per cent, of the males and 10, or 0.1 per cent, of the females were reported as having cancer. These data by age according to sex are shown in Table 6.

As may be seen from that table, for all ages combined the observed number of individuals with cancer exceeds the expected among males but it is less than the expected among females (and among both sexes combined). The ratio of observed to expected number of cases with cancer is 1.29 for males

Table 6. Cancer prevalence among nondiabetics with sinusitis, classified by age and sex, white persons,¹ 25 or more years of age, the National Health Survey, 1935-1936.

AGE (YEARS)	NONDIABETICS WITH SINUSITIS					
	Males			Females		
	Number in Survey	With Cancer		Number in Survey	With Cancer	
		Observed	Expected (2) × (Column 4 of Table 5)		Observed	Expected (5) × (Column 10 of Table 5)
(1)	(2)	(3)	(4)	(5)	(6)	(7)
25-34	1,691	1	.26	2,485	0	.84
35-44	1,847	4	1.03	2,187	7	2.82
45-54	1,084	3	1.83	1,294	1	3.66
55-64	523	2	2.38	770	1	3.88
65-74	243	1	2.23	355	1	2.52
75-84	59	0	.78	72	0	.84
85-99	5	0	.05	7	0	.09
TOTAL-25-99	5,452	11	8.56	7,170	10	14.65

¹ Includes a small percentage with color unknown but excludes Mexicans residing in California and Texas.

but it is not statistically significant.⁹ These findings compared with those for diabetics are shown in Figure 3. Since cancer was not more frequently reported than expected among nondia-

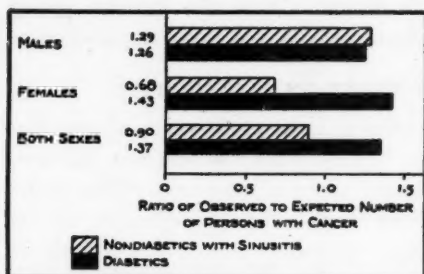


Fig. 3. Cancer prevalence among diabetics and among nondiabetics with sinusitis, white persons, 25 or more years of age, included in the National Health Survey, 1935-1936.

cancers than do the general population.

Judged by the reported cancer prevalence among the total survey population, the findings from the National Health Survey indicate that cancer is more prevalent than expected among diabetics but not among persons with sinusitis. Moreover, since the total population consists of persons with various conditions, some of which may be associated with cancer even as diabetes appears to be, it would be more valid to evaluate the significance of the data for diabetics by means of the cancer prevalence among nondiabetics with sinusitis. Unfortunately, the population and cases for that group are too small to permit such analysis. It should be noted, however, that the reported cancer prevalence rates, standardized for age on the basis of the age distribution of all persons included in the survey, are more than twice as great among diabetics than among nondiabetics with sinusitis (2.09 times greater among males and 2.98 among females).

⁹ The probability of obtaining a deviation from the expected as great or greater than that observed is .24 for males.

¹⁰ Theoretically, nondiabetics with sinusitis constitute an excellent control group for evaluating the data in regard to cancer among diabetics. While this would be true in the case of an intensive diagnostic survey, it is questionable whether sinusitis would be as completely reported as diabetes in the presence of cancer.

betics with sinusitis, it is improbable that the survey data are biased by the extent of cooperativeness of respondents.¹⁰ It is also doubtful whether the data are materially biased by the fact that diabetics may know of a greater proportion of existing

VALIDITY OF THE DATA

The physicians or hospitals reported to have attended cases of illness were requested to confirm or change the family diagnoses. In addition, copies of death certificates for fatal illnesses were obtained in order to verify statements of cause of death. However, only a small proportion (26.3 per cent) of all reported diagnoses could be checked in this manner due primarily to two factors: (a) not all persons included in the survey had had a medical attendant during the year covered by the survey; and (b) not all physicians could or did supply the requested medical information.

It would not be consistent to use the physician's reports (or statements of cause of death from death certificates) where available and the family's reports in other cases; for this and other reasons, the family respondent's statements only have been used in tabulating the data presented herein. How reliable are the diagnoses given by the family respondents?

First, it should be noted that for those statements which could be compared, an agreement of about 90 per cent (between the family's and the physician's statements was found in terms of classifications of diagnoses into 15 to 30 groups. The extent of agreement of two of the three diagnostic groups used in this study was approximately similar to the average for all diagnoses, cancer, 89.4 per cent and sinusitis, 90.4 per cent; while for the third, it was above the average, diabetes mellitus, 96.2 per cent. Second, for several cases of disagreement, it was evident that the physician was not familiar with the condition mentioned by the family, primarily due to the fact that he was not the physician who treated the patient for the particular illness but also partly because of inadequate medical records in the physician's office or hospital. Thus, it is probable that the diagnoses used herein are reasonably accurate.

Were all diabetics and persons with cancer reported? From experience with data from various surveys, it is reasonable to expect that various known diagnostic conditions would be under-reported in varying degrees. Comparison of the data on

diabetics with those obtained from the Massachusetts survey during 1929-1931 would seem to indicate the essential completeness of the National Health Survey data (22).

The same degree of completeness in reporting of cancer is not evident from the data. This no doubt results primarily from two factors: (a) many respondents will not supply the information in regard to cancer even when known; and (b) others are not aware of the existing cancer or of the fact that the tumor which is known to exist is malignant. Or, how else account for the fact that for those tumors which were not specified as malignant by the family respondent, an agreement of only 60 per cent was found for those statements which could be compared and that for 28 per cent of these reported instances of disagreement the physician specified the tumor as malignant?

In view of the above, it appeared advisable to analyze the data on tumors to assure the validity of the findings in regard to cancer. From such analysis, a significantly greater number of observed cases of tumors (other than those specified as malignant) than expected is found among both male and female diabetics; the ratio of observed to expected is 1.93 for males and 2.29 for females.¹¹

Since there is no *a priori* reason to expect an association between benign tumors and diabetes, part of this observed excess of tumors not specified as malignant may be due to the fact that diabetics know of a greater proportion of existing tumors than do the general population and part to the fact that some of these tumors were malignant. From this analysis, therefore, no evidence is produced to contradict the finding that cancer is more prevalent than expected among diabetics.

It should also be noted that the data do not appear to be biased by variations in the findings by place of residence (broad groupings) of persons included in the survey. No significant differences in the cancer rates among diabetics and among non-

¹¹ In view of the inclusion of nasal polyps and polypoids with tumors, the finding of more observed cases of tumors (other than those specified as malignant) than expected among nondiabetics with sinusitis does not appear to be significant to the present analysis.

diabetics with sinusitis are revealed from an analysis of the data for males and females, 60-69 years of age, classified for those residing in the Northeast, Central, and other areas of the United States.

EXPLANATION FOR EXCESS PREVALENCE OF CANCER AMONG DIABETICS

A greater prevalence of cancer among diabetics than among nondiabetics might be explained by the fact that the pancreas is the primary site in which the excess malignant tumors arise. This hypothesis appears to be supported by Marble's data in which carcinoma of the pancreas constituted 13 per cent of all cancers among a group of 10,000 diabetics (3) and also by data reported on by McKittrick and Root in which 32 per cent of the cancers were of the pancreas among a group of 2,179 diabetics (23), in contrast to 3 to 5 per cent for the total population in the United States (24). Also, Ingelfinger (25) has stated that "Although a definite causal relation between diabetes and pancreatic cancer cannot be established, the two conditions coexist frequently enough for any suggestion of a diabetic state to intensify suspicion of pancreatic cancer if the clinical picture is otherwise suggestive." In contrast, however, Ellinger (5) and Hanssen (7) found no abnormal frequency of cancer of the pan-

Table 7. Cancer of the pancreas among diabetics and among nondiabetics at the time of death, white population, deaths reported in proprietary and municipal hospitals, City of New York, 1937-1939 and 1941.¹

SEX	CANCER OF THE PANCREAS AS PER CENT OF				RATIO OF OBSERVED TO EXPECTED ² NUMBER OF DEATHS	
	Deaths From All Causes		Total Cancer Deaths			
	Diabetics	Non-diabetics	Diabetics	Non-diabetics	Diabetics	Non-diabetics
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Males	0.99	0.79	8.0	4.3	1.23	0.99
Females	0.61	0.70	5.9	3.5	1.43	1.01
BOTH SEXES	0.75	0.75	6.8	3.9	1.32	1.00

¹ Excludes deaths due to accidental causes and others certified by the medical examiner's office.

² Based on proportionate frequency of cancer of the pancreas as a cause of death among all male (or female) deaths in the sample applied to all male (or female) deaths in each group.

Table 8. Prevalence of cancer of digestive organs and peritoneum and of other cancers among diabetics and among non-diabetics with sinusitis, classified by age and sex, white persons, 25 or more years of age, the National Health Survey, 1935-1936.

AGE (YEARS) BY SEX	CANCER OF DIGESTIVE ORGANS AND PERITONEUM AMONG						OTHER CANCERS AMONG				
	All persons in survey			Diabetics		Nondiabetics with Sinusitis	Diabetics		Nondiabetics with Sinusitis		
	Number	Pro- portion	Ob- served	Expected (3) × (Col- umns 5 and 11 of Table 5)	Ob- served		Expected (3) × (Col- umns 2 and 5 of Table 6)	Ob- served	Expected (Columns 7 and 13 of Table 5)-(8)	Ob- served	Expected (Columns 4 and 7 of Table 6)-(7)
						(2)					
(1)											
<i>Males</i>											
25-34	12	.000068	0	.01	0	.11	0	.01	1	.14	
35-44	27	.000158	1	.06	0	.29	1	.14	4	.74	
45-54	88	.000637	2	.41	1	.69	2	.68	2	1.14	
55-64	155	.001894	2	1.61	0	.99	5	2.25	2	1.39	
65-74	137	.003152	0	2.13	0	.77	4	4.07	1	1.46	
75-84	58	.004032	1	.58	0	.24	0	1.90	0	.55	
85-99	3	.001473	0	.02	0	.01	0	.11	0	.04	
TOTAL, 25-99	480	—	6	5.07	1	3.10	12	9.16	10	5.46	
<i>Females</i>											
25-34	10	.000050	0	.01	0	.12	0	.06	0	.72	
35-44	42	.000232	0	.13	0	.51	2	.59	7	2.31	
45-54	80	.000579	2	.70	0	.75	6	2.74	1	2.91	
55-64	118	.001269	4	2.09	1	.98	8	6.22	0	2.90	
65-74	100	.001912	4	2.46	0	.68	10	6.68	1	1.84	
75-84	58	.003096	0	1.94	0	.22	1	2.88	0	.62	
85-99	9	.003077	0	.06	0	.02	0	.19	0	.07	
TOTAL, 25-99	412	—	10	6.49	1	3.28	27	19.36	9	11.37	

¹ Includes a small percentage with color unknown but excludes Mexicans residing in California and Texas.

creas among their diabetics who had cancer. It is thus of interest to analyze the data presented herein to ascertain the prevalence of cancer of the pancreas among diabetics.

First, let us examine the New York City special mortality data (13). As can be seen from columns 2 and 3 of Table 7, no real difference is apparent in the frequency of cancer of the pancreas between diabetics and nondiabetics at the time of death. Cancer of the pancreas, however, does constitute a greater proportion of all cancers among diabetics than among nondiabetics (columns 4 and 5 of Table 7). Furthermore, it is more frequently reported among diabetics than might be expected on the assumption that diabetes and cancer of the pancreas are independently distributed among the dead (columns 6 and 7 of Table 7).

Second, it would be desirable to ascertain this relationship on the assumption that deaths from these two causes fall independently on the total population. Data for this purpose are not available but there may be some value in evaluating the 1940 United States mortality data regarding diabetes and cancer of the digestive organs and peritoneum, which includes cancer of the pancreas. From Table 2 it can be seen that for 753 persons, death was charged to both diabetes and cancer of the digestive organs and peritoneum. This is 35 times the expected frequency, namely, $(39,006) \times (72,775) \div 131,669,275$, or 21.6, and appears to indicate a positive association between diabetes and cancer of the digestive organs and peritoneum.

Thus there are indications from mortality data that diabetes and cancer of the pancreas are positively associated among the dead and that diabetes and cancer of the digestive organs and peritoneum are positively associated in the total population. What is the relationship revealed by morbidity data? Unfortunately, a separate code classification was not assigned to cancer of the pancreas in the National Health Survey. The data for cancer of the digestive organs and peritoneum, therefore, have been analyzed. These data for diabetics and for nondiabetics with sinusitis are given in Table 8.

Judged by the reported prevalence rates for all persons included in the survey, cancer of the digestive organs and peritoneum was reported somewhat more frequently than expected among female diabetics, but not among males. In contrast, both male and female nondiabetics with sinusitis were reported to have fewer cases than expected. None of these findings, however, are statistically significant.

If the greater prevalence of cancer among diabetics is ascribed to the fact that cancer of the pancreas occurs more frequently than expected among diabetics, how may we account for the fact that, according to the National Health Survey data, cancer other than of the digestive organs and peritoneum also is reported somewhat more frequently than expected among diabetics especially the females (columns 8 and 9, Table 8). The latter findings, expectation measured by prevalence among the total survey population, may be significant for females and for both sexes combined but not for males. Similarly, from the United States mortality data for 1940 (Table 2) there are indications that diabetes and cancer other than of the digestive organs and peritoneum are reported as joint causes of death more frequently than would be expected.¹² Finally, analysis of the detailed data for the experience of the George F. Baker Clinic in Boston indicates that for the ten-year period from 1929 to 1938 the reported mortality from cancer other than of the pancreas was greater than expected.¹³

Thus, while available mortality and morbidity data are not inconsistent with the possibility that cancer of the pancreas occurs more frequently than expected among diabetics, they do not support this hypothesis as the complete explanation for the excess prevalence of cancer among diabetics. And if, as may be reasonable to assume, existing cancers of the pancreas are more

¹² The reported number of deaths from both diabetes and other cancers was 595, which is 24 times the expected number— 25.3 or $(39,006) \times (85,608) + 131,669,275$.

¹³ This statement is based on Marble's findings (3) that 13 per cent of all cancers were due to cancer of the pancreas. On this basis, of the 83 deaths reported from all forms of cancer, 11 would be due to cancer of the pancreas and 72 to cancer of other organs. The latter, as is evident from Table 1, exceeds the expected number even if it is assumed that none of the cancers primarily affected the pancreas.

frequently diagnosed among diabetics than among nondiabetics, it would be more probable that some other factor or factors accounted for the excess prevalence of cancer among diabetics.

For practical purposes, therefore, it may be assumed that cancer is more prevalent among diabetics than among nondiabetics. However, though no conclusion is tenable from the evidence presented to explain this phenomenon, the findings appear to indicate that the incidence of cancer is higher among diabetics than among nondiabetic individuals.

SUMMARY

1. The consensus as expressed in the literature supports the hypothesis that cancer occurs more frequently than expected among diabetics.

2. In the two most comprehensive clinical reports in the literature, the data were not controlled for age, sex, color, and period of observation and the significance of the findings was evaluated on the basis of noncomparable control groups.

3. However, even with the elimination of most of the statistical objections to the data as previously published for the experience of the George F. Baker Clinic in Boston, the diabetics are found to have at least one-third more cancer deaths than expected during the ten-year period from 1929 to 1938.

4. Mortality data are relatively easy to obtain but they are subject to misuse and misinterpretation. Those obtained from death certificates alone are not complete, especially for contributory and associated causes.

5. From data on death certificates for deaths which occurred in the United States in 1940, it is shown that in the universe of dead persons cancer was less frequently reported among diabetics than among nondiabetics. This finding is confirmed by data from death certificates and matched hospital case histories for a selected sample of New York City white deaths classified by age and sex.

6. That these data appear to indicate that cancer and diabetes are positively associated is shown by the facts that among

the dead cancer is as frequently associated with diabetes as it is with other conditions (syphilis and tuberculosis) that are generally recognized to be associated with cancer, and that cancer is more frequently associated with diabetes than it is with other conditions (cardiovascular-renal diseases) that are not thought to be associated with cancer.

7. Applying the principle advanced by Wilson that one should use a universe of living persons in order to reason regarding the functioning state of individuals, it is shown that cancer and diabetes were reported as joint causes of death in the United States in 1940 and in New York City in 1930 more frequently than would be expected if these two causes fell independently upon the total population.

8. Morbidity data are difficult to obtain and those collected by canvasses are subject to diagnostic inaccuracy and other possible biases, but they do afford the best source for statistical evidence regarding the functioning state of individuals.

9. Data for white persons, 25 or more years of age, included in the National Health Survey, indicate that cancer is more prevalent than expected among diabetics. Among the 2,912 males and 5,278 females reported as diabetic, cancer was recorded for 18, or 0.6 per cent, of the males and for 37, or 0.7 per cent, of the females. The ratio of observed to expected number of cases of cancer (expectation measured by the prevalence among all persons of specific age groups above age 25 in the survey) was 1.26 for males and 1.43 for females; the findings for males may be due to chance sampling but those for females and for both sexes combined are statistically significant.

10. That these findings do not arise from any known bias in the data is shown by the fact that cancer was not reported more frequently than expected among nondiabetics with sinusitis. Other facts and analyses are cited in substantiation of the quality of the data and the validity of the findings.

11. No conclusion is tenable from the evidence presented to explain the excess prevalence of cancer among diabetics; the findings, however, appear to indicate that the incidence of can-

cer is higher among diabetics than among nondiabetic individuals.

REFERENCES

1. Hoffman, Frederick L.: THE MORTALITY FROM CANCER THROUGHOUT THE WORLD. Newark, N. J., The Prudential Press, 1915, pp. 192-194.
2. Wilson, Edwin B. and Maher, Helen C.: Cancer and Tuberculosis with Some Comments on Cancer and Other Diseases. *American Journal of Cancer*, 1932, 16, pp. 227-250.
3. Marble, Alexander: Diabetes and Cancer. *New England Journal of Medicine*, 1934, 211, pp. 339-349.
4. Joslin, Elliott P., et al.: THE TREATMENT OF DIABETES MELLITUS. Philadelphia, Pa., Lea & Febiger, 1940, 7th Ed., pp. 580-586; 1946, 8th Ed., pp. 653-659.
5. Ellinger, Friedrich and Landsman, Harold: Frequency and Course of Cancer in Diabetics. *New York State Journal of Medicine*, 1944, 44, pp. 259-265.
6. Maynard, G. D.: A Statistical Study in Cancer Death Rates. *Biometrika*, 1910, 7, pp. 276-304.
7. Hanssen, Per: DIABETES MELLITUS IN BERGEN, 1925-1941; A STUDY OF MORBIDITY, MORTALITY, CAUSES OF DEATH AND COMPLICATIONS. Oslo, Norway, Johan Grundt Tanum, 1946.
8. Berkson, Joseph: Limitations of The Application of Fourfold Table Analysis to Hospital Data. *Biometrics Bulletin*, 1946, 2, pp. 47-53.
9. George F. Baker Clinic, Boston, and Metropolitan Life Insurance Company, New York: Diabetes in The 1940's. New York, Metropolitan Life Insurance Company, September, 1940, Chart 10, p. 14.
10. Bureau of the Census, United States Dept. of Commerce: VITAL STATISTICS RATES IN THE UNITED STATES, 1900-1940. Government Printing Office, 1943, Table 23, p. 434.
11. Bureau of the Census, United States Dept. of Commerce: VITAL STATISTICS OF THE UNITED STATES, 1940, Part I. Government Printing Office, 1943, Table 21, pp. 570-623.
12. *Ibid*, p. 569.
13. From a study, jointly sponsored by the New York City Departments of Health and Hospitals, which was directed by the Department of Health with the assistance of a grant from the New York Foundation. The data are based on information recorded on death certificates and matched hospital case histories for all deaths which were reported in proprietary hospitals in 1937-1939 and 1941 and for some of the deaths which were reported in selected municipal hospitals in January and February of those years. Excluded are deaths due to accidental causes and others certified by the medical examiner's office, and those for which hospital case histories could not be obtained. Data from that study for nonwhite deaths have not been used in this paper.
14. Pearl, Raymond: Cancer and Tuberculosis. *American Journal of Hygiene*, 1929, 9, pp. 97-159.
15. Carlson, H. A. and Bell, E. T.: A Statistical Study of the Occurrence of Cancer and Tuberculosis in 11,195 Post-mortem Examinations. *Journal of Cancer Research*, 1929, 13, pp. 126-135.

16. Levin, Morton L., *et al.*: Syphilis and Cancer. *New York State Journal of Medicine*, 1942, 42, pp. 1737-1744.
17. Wilson, Edwin B.: Morbidity and The Association of Morbid Conditions. *Journal of Preventive Medicine*, 1940, 4, pp. 27-38.
18. Department of Health, City of New York: Joint Causes of Death. *The Weekly Bulletin*, 1931, 20, pp. 333-340.
19. See reference 11, Table 11, p. 224.
20. Perrott, George St. J.; Tibbits, Clark; and Britten, Rollo H.: The National Health Survey—Scope and Method. *Public Health Reports*, 1939, 54, pp. 1663-1687. Reprint No. 2098.
21. Britten, Rollo H.; Collins, Selwyn D.; and Fitzgerald, James S.: The National Health Survey—Some General Findings. *Public Health Reports*, 1940, 55, pp. 444-470. Reprint No. 2143.
22. Spiegelman, Mortimer and Marks, Herbert H.: Age and Sex Variations in the Prevalence and Onset of Diabetes Mellitus. *American Journal of Public Health*, 1946, 36, pp. 26-33.
23. McKittrick, L. S. and Root, H. F.: *DIABETIC SURGERY*. Philadelphia, Pa., Lea & Febiger, 1928.
24. Hoffman, Frederick L.: Cancer of the Pancreas. *New England Journal of Medicine*, 1934, 211, pp. 65-169.
25. Ingelfinger, Franz J.: The Diagnosis of Cancer of the Pancreas. *New England Journal of Medicine*, 1946, 235, pp. 653-661.

ANNOTATIONS

CALCIUM AND PHOSPHOROUS IN FOODS AND NUTRITION¹

Dr. Sherman's little book, 115 pages of text plus a 44-page selected bibliography and an adequate index, was intended by the author to be useful to both students and professional workers, "whether in teaching or in practical dietetics, research, nutrition policy, or food management." The book is all of that and, in addition, research workers and practitioners in branches of the medical sciences other than nutrition undoubtedly will be interested in Dr. Sherman's exposition of his philosophy of optimum health. The liberal bibliography on experimental work in the field of calcium and phosphorous metabolism by itself makes this book a desirable item for the reference shelf of all workers in the field of nutrition. The mass of facts and experimental data in the text is well indexed, further increasing the value of the book for reference purposes.

In spite of the large amount of data and references to experimental work which Dr. Sherman has included in its 115 pages, the book is quite easy and very interesting reading. The data given regarding the levels of calcium and phosphorous in the various tissues of the body at various ages and under various metabolic conditions, along with background information on how these figures were derived, are very useful. The same must be said of the information given on the calcium and phosphorous content of foods and the factors conditioning the availability of these elements in foods to the animal organism, but, for this reviewer, the greatest interest and importance is attached to Dr. Sherman's exposition of the meaning of optimum nutrition and

¹ Sherman, Henry C.: CALCIUM AND PHOSPHOROUS IN FOODS AND NUTRITION. New York, Columbia University Press, 1947. \$2.75.

optimum health. The utility of this concept goes far beyond the field of calcium and phosphorous metabolism. A few direct quotations from the book should serve to interest the readers of this review sufficiently to read the work in its entirety:

"Passably normal health can be maintained for a lifetime and even through successive generations—on very different levels of calcium intake and output—. Yet differences within the range of this normal zone may influence the degree of positive health and of satisfactoriness of individual and family life history attained;—."

"Hence the most scientific ground to take on this subject at present would seem to be that somewhat over one gram each of calcium and phosphorous is advantageous in human nutrition; and that with intakes of both of these elements at this approximate level we have no occasion for anxiety as to the precise ratio between them."

"—, it may well be pointed out here that the principle of the nutritional improvability of the norm (is) now so well established by recent and current research upon the full-life and successive-generation effects of different liberal levels of calcium and of vitamin A,—."

ROBERT S. GOODHART, M.D.





THE JOURNAL OF THE

QUARTERLY

APRIL 1948

TWENTY
CENTS

VOL. XXV
NO. 1